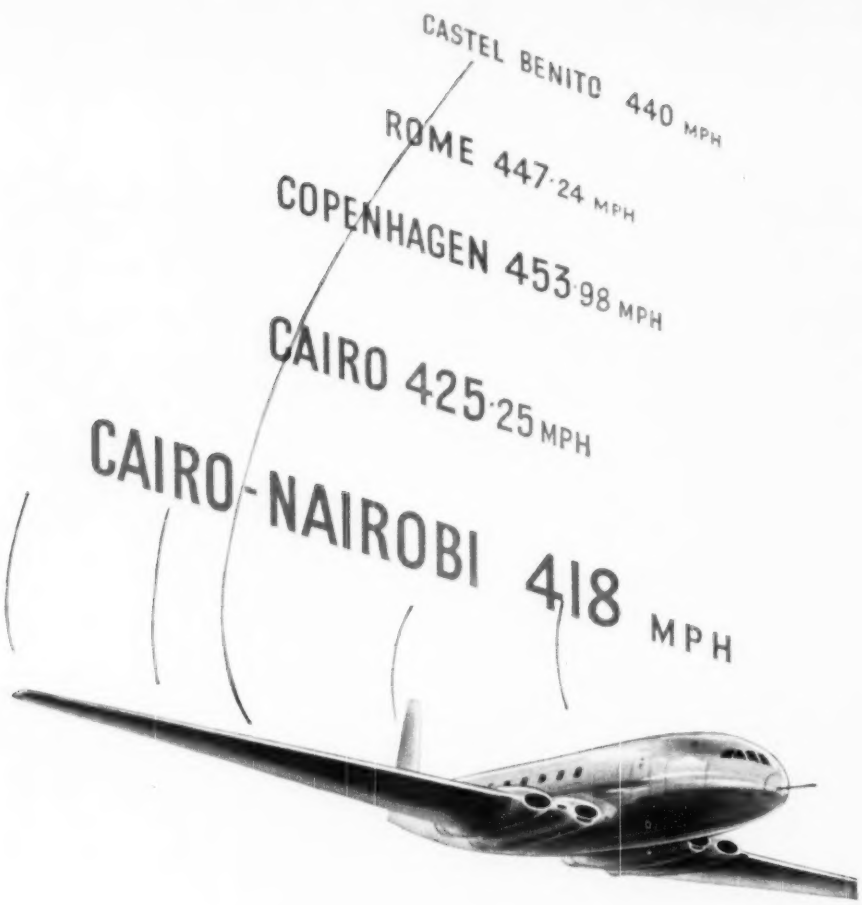
5 OCTOBER 1950 ONE SHILLING

FLIGHT

and

AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB



The Record-breaking
de Havilland
"COMET"
is equipped with
BICC "Pren" Aircraft Cables
for all electrical services under
strenuous flying conditions.

BI Callender's

"PREN" AIRCRAFT CABLES

BRITISH INSULATED CALLENDER'S CABLES LIMITED
NORFOLK HOUSE, NORFOLK STREET, LONDON, W.C.2

YA 5
Anti-submarine
Aircraft
for the Royal Navy
Powered by a
ROLLS-ROYCE
GRIFFON
or
ARMSTRONG SIDDELEY
DOUBLE MAMBA
BLACKBURN and GENERAL AIRCRAFT LIMITED
BROUGH E. YORKS
5088/5

The BALLIOL T.2.

ROLLS-ROYCE MERLIN 35 ENGINE

Advanced Trainer.

- HIGH PERFORMANCE
- GOOD MANŒUVRABILITY
- ROBUST CONSTRUCTION
- QUICK SERVICING
- SIMPLE REPAIR

The Choice of the R.A.F.

BOULTON PAUL AIRCRAFT LTD.

WOLVERHAMPTON, ENGLAND

"SILVER FOX"
REGD. TRADE MARKS

"SILVER FOX"
STAINLESS STEELS

for

STRENGTH

UTILITY

BEAUTY

• SHEETS • COLD ROLLED STRIP • WIRE • BARS • FORGINGS

THE UNITED STEEL COMPANIES LTD

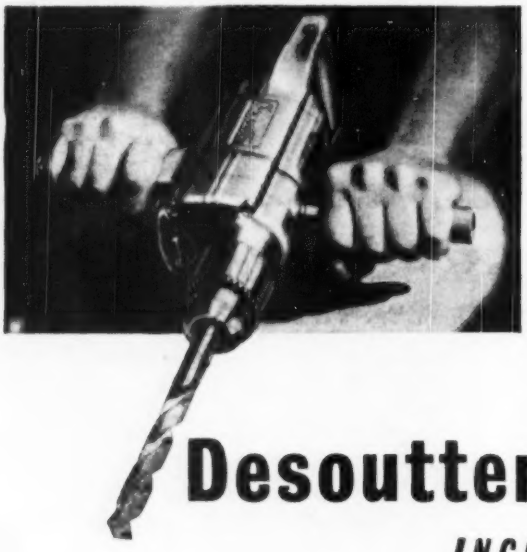
SAMUEL FOX & COMPANY LIMITED
Branch of The United Steel Companies Limited
STOCKSBRIDGE WORKS · NR. SHEFFIELD · ENGLAND

F 252

I guess a guy don't need two guns now

The hombres in these parts is so tough that if y'wanted to shoot a guy, y'had to drill him with a small calibre gun first and then use a large calibre to open up the hole. Like engineers drilling thro' steel and sich. But this noo Desoutter Two Speed Gun does it all — over 1,000 r.p.m. to drill the liddle hole; then down to around 500 to open him up.

If you want to go on living in a competitive world (and we ain't all Socialists yet!) you had sure better write for Leaflet G.2



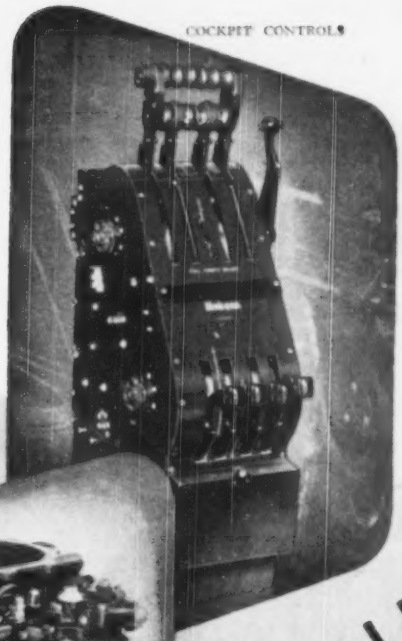
G.2 and **H.2** are the present descriptions of two entirely new Desoutter Two Speed Drills, which for performance, weight, size and cost we believe to be without precedent in small power tools. Please write for Leaflet.

Desoutter *POWER TOOLS*

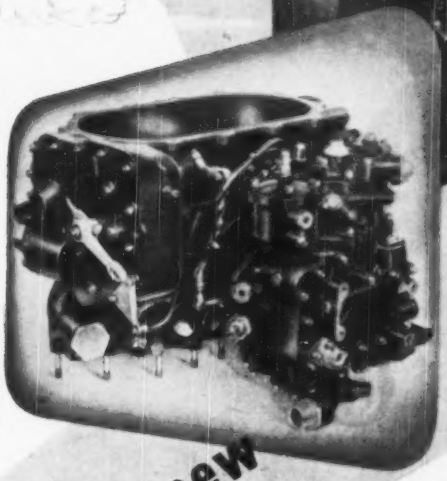
INCREASE PRODUCTION

DESOUTTER BROS. LTD., THE HYDE, HENDON, LONDON N.W.9 • TELEPHONE: COLINDALE 6346 (5 LINES) • TELEGRAMS: DESPNUCO, HYDE, LONDON

CDC 216



COCKPIT CONTROLS



INJECTION CARBURETTERS

on the new Universal Freighter

For maximum reliability and fuel economy, the Bristol Hercules engines of Britain's largest freighter aircraft are equipped with HOBSON Injection Carburetters.

Control of engine power and r.p.m. is also provided by dual HOBSON Cockpit Controls. These latter units allow for the additional control of the braking propellers through aft movement of the pilot's throttle levers from the fully-closed positions, and automatically safeguard against engine stall during propeller reversal, engine overspeed during the propeller zero pitch range, and swing of aircraft when applying propeller braking. The Blackburn & General Aircraft Company is yet another leading manufacturer to rely on HOBSON experience, knowledge and traditions of quality.

Hobson

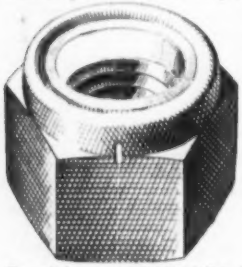
CARBURETTERS · COCKPIT CONTROLS

H. M. HOBSON LTD. FORDHOUSES, WOLVERHAMPTON. *Licensees in U.S.A. and Canada Simmonds Aerocessories Inc.*

..but nothing rattles the NYLOC

Regd.

it has a NYLON insert... The insert is made of a special nylon and it gives the Nyloc immense tenacity even under intense vibration. Once you have screwed this new self-locking Nut home on a bolt it will never loosen its grip though it be soaked in oil, petrol, paraffin or glycol; boiled in water or frozen at –60°C. Yet any Joe Soap with a spanner could whip it off in a jiffy.



**Approved by the Royal Aircraft Establishment, Farnborough, for use in all types of aircraft.*

SIMMONDS NYLOC SELF-LOCKING NUT

Enquiries to: SIMMONDS AEROCESSORIES LIMITED, BYRON HOUSE, 7-8-9 ST. JAMES'S STREET, LONDON, S.W.1
Head Office and Works: TREFOREST, GLAMORGAN. *Also* BIRMINGHAM · STOCKHOLM AND MELBOURNE

4748

Imagine an island . . .

It is roughly 500 miles square and has two towns, both populated by executives and employees of mining and trading companies. There are no railways and few roads. The interior, where large mineral deposits are situated, is rocky and well wooded, with a number of lakes and rivers. It lies off the trunk air routes and has to be served by feeder airline to the mainland.

Shorts have designed the Sealand for all areas in which the conditions of this island are repeated, and similar enterprises are considered.

The Sealand has proved itself a thoroughly economical proposition, for it carries 8 passengers, or 6 passengers with their baggage and 80 lb. of freight, to and from the island, travelling over 300-mile stretches of sea at an average speed of 127 m.p.h.

As a freighter it carries 1,000 lb. for a distance of nearly 700 statute miles without having to strip any of the furnishings to accommodate this load.

Private companies, with extensive interests in the agricultural and fishing industries of the island, find the Sealand incomparable for accelerating the development of their enterprises; where fleets of trawlers are operating they are easily controlled from the air while at sea.

Crop spraying and dusting, forest fire patrol, and personnel transport are all within its range of duties. In fact, the general manager's office can be taken right into the heart of the plantation or the fishing ground.

For rocky and difficult interior country, where the going is hard, the Sealand once again is indispensable. Lakes and rivers can be used as landing places for flying in new equipment, stores, and personnel, geological and geographical surveys and mineral prospecting can easily be undertaken, while in an emergency it is quickly converted into a comfortable and speedy air ambulance.

The Sealand can take off at full load from 835 yards of water or from a forest clearing 450 yards in length.

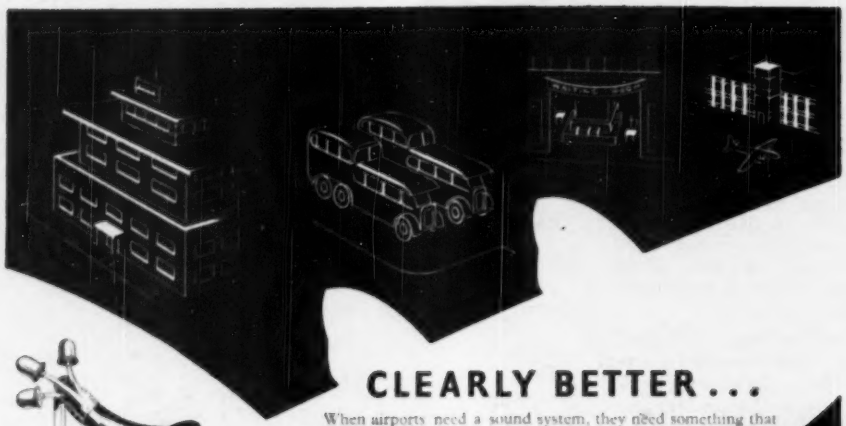
Feeder Lines, Charter Companies, and private or official concerns should write now for further details.

DESIGNED FOR AREAS WHERE FREIGHT AND PASSENGER CARRIAGE IS IMPRACTICABLE FOR NORMAL AIRCRAFT

THE SEALAND AMPHIBIAN

Shorts *THE FIRST MANUFACTURERS OF AIRCRAFT IN THE WORLD*

Short Brothers & Harland Limited, Queens Island, Belfast *London Office:* 17 Grosvenor Street, W.1



CLEARLY BETTER . . .

When airports need a sound system, they need something that will reproduce words and music as clearly as they were delivered to the microphone, and in spite of weather and similar distracting conditions. You can count on simplicity of installation, ease of control and economy as well.

If you have a sound problem we could help you with, we'll be glad to give you details—if you'll write to the address below.

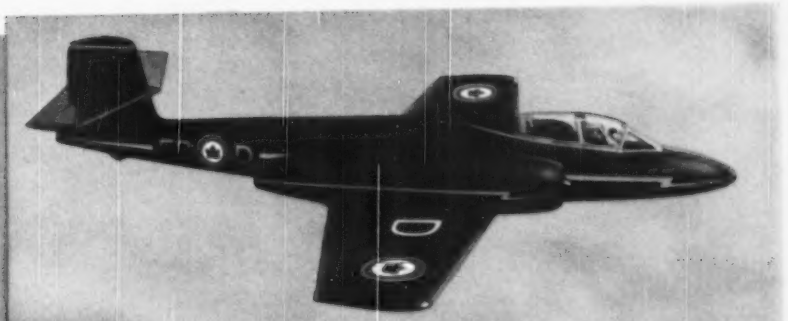
G.E.C. AIRPORT BROADCAST CALL EQUIPMENT

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

There's much more in **good sheet metal work** besides a hammer and a lot of noise. We know, because for many years we have produced work **for the aircraft industry** to the most exacting requirements and, incidentally, to the user's complete satisfaction. This portable oxygen set container for British Overseas Airways Corporation is a typical example—perhaps our skill, experience and manufacturing facilities can help to solve one of your problems — whether it involves spinning forming, pressing or fabrication.

CORNERCROFT LTD.

ACE WORKS, COVENTRY and 32, Clarges St., London, W.1. Telephone: Grosvenor 1646



AVRO CANADA C.F. 100

AVRO CANADA C. 102

both

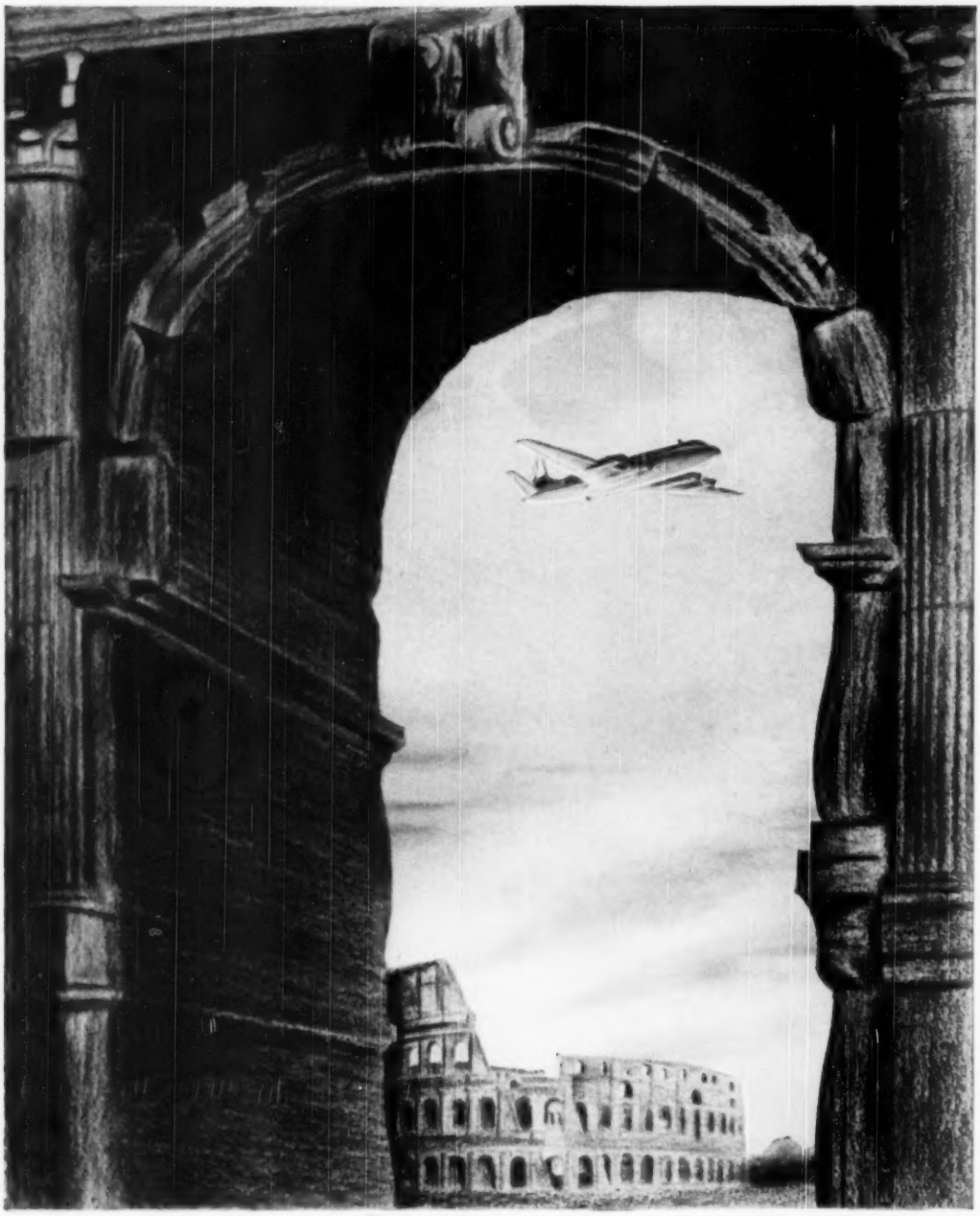
DOWTY *Equipped*

Live-Line Pump and Hydraulic System

Liquid Spring Main and Nose Undercarriages with powered steering

DOWTY EQUIPMENT LIMITED · CHELTENHAM

DOWTY EQUIPMENT OF CANADA LIMITED · AJAX · ONTARIO



THE VICKERS VISCOUNT (FOUR ROLLS-ROYCE DART PROPELLER-TURBINES)

The Viscount will bring quicker, safer and smoother flight between the great cities of the world — and a standard of luxury and reliability so far unknown in air travel.

VICKERS-ARMSTRONGS LIMITED, VICKERS HOUSE, BROADWAY, LONDON, SW1.

AT92

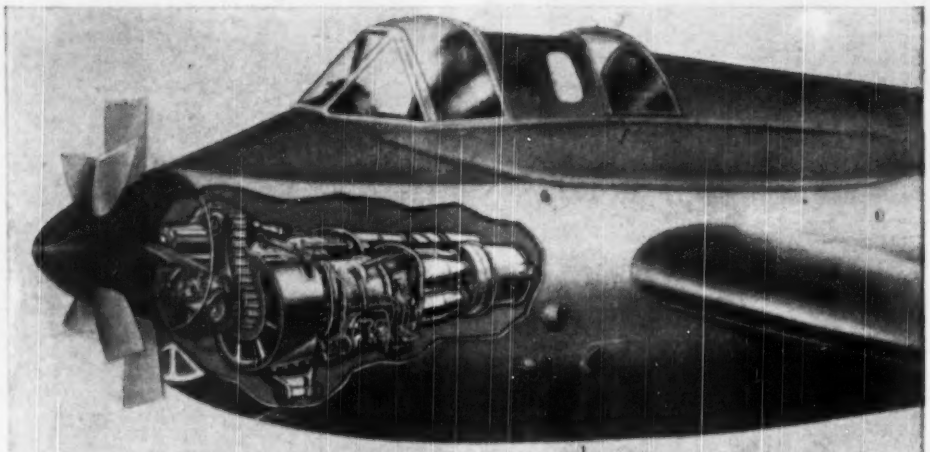
The FOKKER S.11 Jet Trainer is fitted with

DUNLOP

tyres · wheels · brakes · pneumatic control equipment · flexible pipes

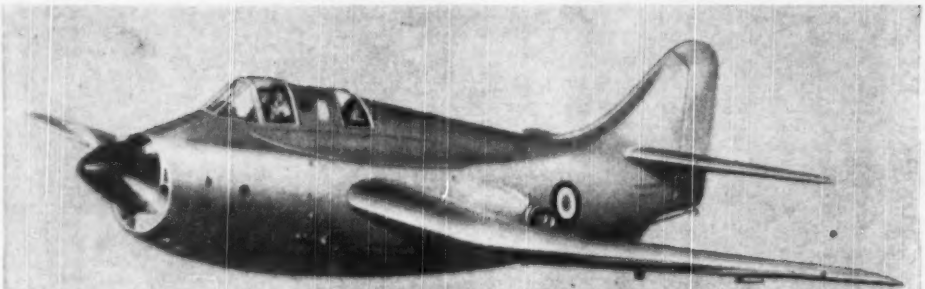
DUNLOP SERVES WORLD AVIATION

DUNLOP RUBBER CO. - LTD. - (AVIATION DIVISION) COVENTRY



THE ENGINE THAT DRIVES

(Armstrong Siddeley "Double Mamba")



THE AIRCRAFT THAT STRIKES

Twin Engine Performance—Single Engine Installation

FLIGHT
and
AIRCRAFT ENGINEER

First Aeronautical Weekly in the World

Founded 1909

No. 2180. Vol. LVIII. THURSDAY, 5 OCTOBER, 1950

EDITORIAL DIRECTOR
G. GEOFFREY SMITH, M.B.E.

EDITOR
MAURICE A. SMITH, D.F.C.

ASSISTANT EDITOR
H. F. KING, M.B.E.

TECHNICAL EDITOR
C. B. BAILEY-WATSON, B.A.

ART EDITOR
JOHN YOXALL

Editorial, Advertising and Publishing Offices :

DORSET HOUSE,
STAMFORD STREET,
LONDON, S.E.1.

Telegrams : Flightpres, Sedist, London.
Telephone : Waterloo 3333 (60 lines).

Branch Offices :

COVENTRY
8-10, Corporation Street.
Telegrams : Autocar, Coventry.
Telephone : Coventry 5210.

BIRMINGHAM, 2.
King Edward House,
New Street.
Telegrams : Autopress, Birmingham.
Telephone : Midland 7191 (7 lines).

MANCHESTER, 3.
260, Deansgate.
Telegrams : Iliffe, Manchester.
Telephone : Blackfriars 4412 (3 lines).
Deansgate 3595 (2 lines).

GLASGOW, C.2.
26b, Renfield Street.
Telegrams : Iliffe, Glasgow.
Telephone : Central 4857.

SUBSCRIPTION RATES

Home and Overseas : Twelve months £3 1s. 0d. Six months, £1 10s. 6d. U.S.A. and Canada, $10.00.

BY AIR : To any country in Europe (except Poland). Twelve months, £5 1s. 0d. Six months, £2 10s. 6d. Canada and U.S.A. Six months, $16.

In this issue:

Short Flight-test Development 374
News in Views 377
Fighter Armament 379
Science and War 382
Nations and Airways 384
This Year's Models 389

Looking Seaward

TO British eyes one of the most gratifying manifestations at this year's S.B.A.C. Display was the healthy-looking family of ten prototype and production-type aircraft marked "Royal Navy." Three of these—the Fairey Firefly, Hawker Sea Fury and Percival Sea Prince—are established in service; the Firefly and Sea Fury, in fact, already have a lengthy and honourable career behind them. Though not yet operational, three other types—the Hawker Sea Hawk, Supermarine Attacker and Westland Wyvern—are on order; but the remaining four (Blackburn Y.B.1, Fairey 17, Short S.B.3 and Supermarine Seagull) are as yet unadopted.

This is the view presented, as it were, through the shop window. Later and yet more potent types than those displayed are doubtless concealed under the counter; but it is the common run of goods in everyday use which is our immediate concern.

To-day, the Navy's "bread-and-butter" fighters are still piston-engined Seafires, Sea Furies and Sea Hornets, supported by a mere handful of jet-propelled Sea Vampires; so the news that Attackers are already coming off the production line is indeed welcome. Though the pleasing prospect of Sea Hawk squadrons is more remote, the Naval fighter situation in general cannot be said to be perilously insecure. Regrettably, the same is not true of the specialized strike and anti-submarine classes which, it must be remembered, might be called upon to bear the brunt of future battles.

The present situation is that carrier-borne strike duties fall mainly to the lot of Firebrands and Barracudas, though dive-bombing and rocket attacks can, of course, be undertaken as a secondary rôle by the piston-engined fighters earlier named. For torpedo-bombing operations the introduction of the Wyvern is—happily—imminent, but a lengthy period must ensue during which anti-submarine duties will devolve mainly upon Fairey Fireflies. Even in its present form the Firefly is a valuable anti-submarine weapon, and further development will emphasize the "sub"-hunting and killing proclivities inherent in the design; nevertheless, this stalwart Fairey can hardly rival such specialized machines as the "17" by the same makers, the Blackburn Y.A.5 and Y.B.1, or the Short S.B.3. This being so, orders for one or more of the new breed of deck-landing anti-submarine aircraft are urgently awaited. While it is recognized that testing and development must occupy a period of some months, protracted indecision in respect of these aircraft must inevitably unbalance our Naval air arm to danger-point.

This Issue of "Flight"

When our issues of September 7th and 14th appeared in somewhat abridged form we expressed the hope that the cause of the shortcomings—a labour dispute affecting a section of the London Printing industry—would soon be settled. With the appearance of the two succeeding issues it seemed that our hope had been realized. Last week, however, the trouble broke out anew, with the result that the present issue has had to be produced under severe difficulties, which are inevitably reflected in its size and in the space devoted to regular features. No promises can be made as to the immediate future, for the circumstances lie beyond our control; we can only express our intention of continuing to make every effort to give our readers at least the essential news of happenings and developments in world aviation.

Seen en route to Farnborough for the S.B.A.C. display, the Sealand shows features to which Mr. Marshall refers, notably the strips along the after-body chines and the latest cowling and cooling arrangements.

SHORT FLIGHT-TEST DEVELOPMENT

Ingenious Solutions to Aerodynamic and Other Problems in the Sealand and Sturgeon

By S. G. MARSHALL, B.A. (Cantab), A.F.R.Ae.S.

THIS frank and informative summary of the flight-test development of two well-known aircraft is from the pen of the chief aerodynamicist, Short Brothers and Harland, Ltd. It is especially interesting in that it demonstrates how seemingly trivial aerodynamic and hydrodynamic improvements can influence the handling and performance of modern aircraft, and how a relatively small expenditure of time and money may be abundantly rewarded.

IT is now established routine in the aircraft industry that all new aircraft types, before entering service, undergo an extensive programme of flight trials. This is both to prove the aircraft airworthy and safe to fly and also to ensure its suitability for airline or Service operation.

What is not so widely appreciated is the important work of refinement which forms an essential part of these proving trials. Largely because of the critical weight factor, the margin between success and failure is probably more slender in aircraft design than in any other form of engineering. Consequently, it is the aircraft constructor who pays the greatest attention to refinements of design and construction (not only in the design stage but also later during flight development) who produces the most satisfactory and economic aircraft.

This article summarizes typical interesting work of this kind carried out during the prototype flight trials of the Sealand amphibian. Now that this aircraft has been granted a full temperate and tropical Certificate of Airworthiness it is interesting to read of the development work necessary to attain that mark of quality. Finally, an instance of similar work on other Short aircraft is given.

During early flight trials, the Sealand was characterized by acute sensitivity of response to throttle movement at low speed. Being a twin-engined aircraft, therefore, this resulted not only in difficulty in making the normal last-minute adjustments to flight path during the approach (to prevent either an under- or overshoot), but also produced unpleasant yawing effects with small differential throttle movement. This would have been most uncomfortable for passengers and would have made the pilot's task of making a good landing extremely difficult, particularly on small, restricted aerodromes.

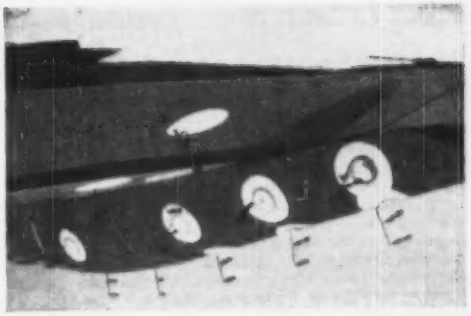
The first explanation offered was that there might be flow breakaways from the wing-engine nacelle junctions which, in normal flight, were being cleaned up by airscrew slipstream. Any throttling of the engine would then introduce additional aircraft drag as well as remove the normal airscrew thrust. However, although with the original high engine nacelles this effect may have been contributory, the major cause of the trouble was eventually traced to the airscrews. For improved take-off efficiency, these had been allowed a finer blade setting than usual at low speed, which, on throttling the engines during the approach to land, resulted in excessive windmilling drag from the airscrews. A change to airscrews of lower diameter and a coarser fine-pitch stop was therefore made, and this restored a more normal response to throttle control during landing.

A rather similar difficulty was experienced in the fore-and-aft handling of the Sealand, once again at low speeds. This effect, however, was independent of throttle movement and was accompanied by a deficiency in stability, ragged stall characteristics and loss of climb performance. The solution, in this instance, was more difficult to determine, but, at least in part, was eventually found to be a remarkably simple one. As in the case of the Sturgeon, to which reference is made later, the trouble was found to be due to disturbed airflow over the wing centre-section. The flaps in the Sealand are essentially a mixture of the split and plain types and, particularly when fully lowered as for landing, a considerable flow of air is drawn through the leading edge gap from the lower surface of the wing to the top. This resulted in the initiation of a considerable turbulence and flow breakaway from the top surface of the wing at the flap junction. A photograph herewith shows wool tufts on an experimental version of the Sealand nacelle. The curious behaviour of the tuft mounted on the flap is evidence of the breakaway. This was almost entirely eliminated by incorporating a fabric seal at the lower sur-

face junction and also sealing all lightening holes in the rear spar, which also forms the wing trailing-edge in way of the flaps. The resulting effect on the handling qualities of the aircraft was extremely beneficial, the greater part of the deficiencies mentioned above being eliminated.

During the course of the engine cooling trials on the Sealand, considerable development work was carried out, not only to obtain the best cooling arrangements possible for tropical operation, but also to improve climb performance. Many quite minor modifications of the type shown in the accompanying diagrams were tried and that illustrated last was finally accepted. It will be noted that all the modifications were of a relatively simple nature, with the possible exception of the switch of the oil coolers from the top of the engine nacelles to the wing leading-edge. The resulting improvements in cooling and performance for tropical operations were far from insignificant, however. Peak cylinder temperatures were reduced by 20 deg C, oil temperatures by 15° deg C, and the rate of climb of the aircraft improved by 50ft/min. The improvement in performance was of particular importance in view of the inevitable critical state of affairs that exists when a twin-engined aircraft suffers an engine failure.

The Sealand, being an amphibian, naturally had its problems peculiar to water operation. One of these which soon became apparent during the early water handling trials was a tendency to angle back excessively at what is known as "hump speed." All flying boats of the conventional two-step variety take off from water in two distinct stages. During the first stage, up to approximately 35 knots on the Sealand, the boat is supported mainly by normal water buoyancy. The fore-and-aft trim normally increases until at the end of the buoyance stage (the "hump") the rear step lifts clear and the boat rides only on its forebody. During the second stage of the water run the aircraft is then supported partly by water planing loads on the forebody and by air-lift in the wings. If the change of trim at hump speed is too great (as it was with the Sealand) there is a tendency for a porpoise to be set up during this transition period. This fault was not dangerous with the Sealand, but considerable skill and concentration on the part of the pilot was required to effect a smooth take-off. The trouble was largely eliminated by the introduction of ¼in strips along the afterbody chines and by sharpening the new step just forward of the retracted tail wheel. It is believed that the angle of trim and tendency to porpoise were reduced because these sharp edges destroyed water suction on the afterbody, which was tending to keep the tail down.



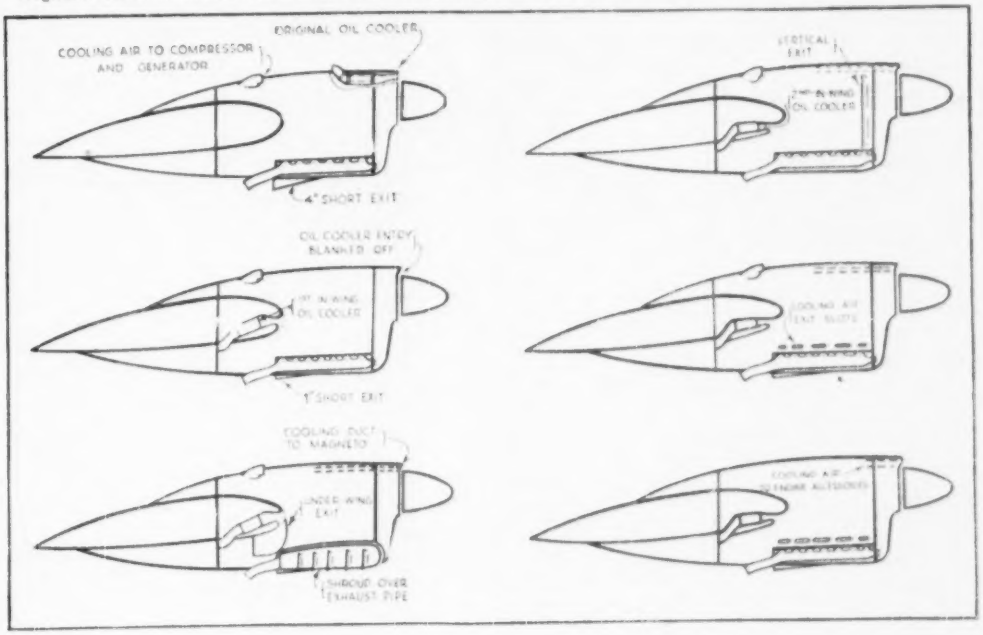
Wool tufting on an experimental Sealand nacelle. The curious behaviour of the tuft on the flap is evidence of flow breakway.

A similar phenomenon has recently been experienced in America. There it was found, whilst tank-testing flying-boat models, that in order to obtain realistic trims during water runs the chines of the model planing surfaces needed to be razor sharp, otherwise excessive trimming angles were obtained as experienced on the full-scale Sealand.

STURGEON DEVELOPMENT

The liquid-cooled Merlin engines of the twin-engined Sturgeon deck-landing aircraft are cooled by means of radiators placed in the wing leading-edges between fuselage and engine nacelles. The normal leading-edge profiles of

Progressive Sealand modifications to obtain the best cooling arrangements for tropical operation and to improve climb performance.



SHORT FLIGHT-TEST DEVELOPMENT

the wing centre-section were consequently modified at the design stage to incorporate the requisite cooling duct entries. However, following early flight reports of low-speed instability, difficulty in control during landing, poor climb performance, and draught down the pilot's neck, a systematic programme of entry lip development by flight test was initiated. Local ragged airflow characteristics had been verified by wool-tufting the wings. Various lip shapes were tried in turn (constructed of wood for convenience) and the optimum shape eventually determined. The improvements achieved by this means were quite remarkable and not confined purely to handling. The low-speed instability was eliminated, elevator control improved, and stalling speed reduced from 74 knots to 68 knots, with a corresponding improvement in deck-landing attitude. In addition, the rate of climb was increased from 2,000 ft/min to 2,800ft/min, the maximum speed increased by 20 knots, engine coolant temperatures dropped by 10 deg C and, perhaps most important of all, pilots no longer complained of stiff necks.

Showing the Sturgeon centre-section radiators which were subject to modifications mentioned by Mr. Marshall.

It is noteworthy that these improvements were all associated with improved airflow, both external and internal through the radiators. It is considered that the results achieved constitute a glowing testimonial to the merits of aerodynamic refinement and, to a lesser degree, to the use of wool tufts for flow investigation.

The foregoing paragraphs illustrate some recent examples of the considerable benefits to be accrued from what might be termed "quality investigation" during prototype flight trials. The value of wool tufts in locating the region in which the trouble lies is also emphasized. It is evident that a little time and money spent at this relatively later period of a prototype aircraft's development may pay handsome dividends and ensure that the subsequent production aircraft enter service as really efficient, operational machines. As in the case of the Sturgeon radiator lips and the Sealand cooling modifications, the refinement process may be somewhat of the "hit or miss" variety, and, as a consequence, sometimes rather prolonged and tedious. Nevertheless, this appears justified when a really worthwhile improvement in aircraft characteristics finally results. (Having noted the foregoing results, the reader will agree. *Ed.*)

STANDARDIZED POWER-CONDITIONS

FOLLOWING the I.C.A.O. policy of international standardization, the ratings of all British power-units are now quoted—by the S.B.A.C., A.R.B. and Ministry of Supply—according to a standard form of nomenclature for the main operating conditions. Some terms, supplementary to the I.C.A.O.-approved titles, have been introduced by the Ministry of Supply to cover military as well as civil operating conditions. The new nomenclature is set out in the following tables:—

PISTON-ENGINE OPERATING CONDITIONS

Power	Time Limit	Military or Civil	Remarks
Max take-off	5 min	M and C	—
Operational necessity	5 min	M	May in some cases be increased to 10 or 15 min if required.
Max intermediate	60 min	M	Often same power as max continuous.
Max continuous	Unrestricted	M and C	—
Max weak mixture	Unrestricted	M and C	Minimum r.p.m. sometimes specified for this condition.
Max overspeed	20 sec	M and C	Usually 105 per cent of max. take-off r.p.m. but may be higher.

TURBOJET AND TURBOPROP OPERATING CONDITIONS

Power	Time Limit	Military or Civil	Remarks
Max Take-off	5 min	M and C	—
Operational necessity	5 min	M	May be increased to 10 min in some cases.
Max take-off and operational necessity	10 or 15 min	M	
Max intermediate	30 min	M	Frequently the same as max continuous.
Max continuous	Unrestricted	M and C	—
Max overspeed	20 sec	M and C	Usually 103 per cent of max take-off r.p.m.
Approach idling	Unrestricted	M and C	For use on landing approach. To enable max power to be reached within 5 sec.
Ground idling	Unrestricted	M and C	For use with no forward speed.

A third set of operating conditions has also been laid down for application to civil piston-engines rated before November 1st, 1946, and not subsequently approved to current B.C.A.R. (I.C.A.O.) standards, *e.g.*, Merlin 500 Series. There are five power-conditions: emergency max (15 min); max climbing (60 min); international rated (60 min); emergency cruising and max cruising (both unrestricted).

OBITUARY

ALL those in the industry who knew him will be grieved to learn of the death of Mr. W. H. ("Bill") Mace, who in 1921 joined Hawker Aircraft, Ltd. (at that time H. G. Hawker Engineering Co., Ltd.), as works inspector. A year or so later he became works manager, which position he held until he left the firm 14 years later to go to British Marine Aircraft of Southampton as a director. During the war he was with M.A.P. For several years latterly he had been suffering from a severe illness, and it was this that led to his death—on September 23rd, at Downderry, Cornwall, where he had been living for the last few years.

Flight also regrets to record the passing, which occurred recently in a Belfast hospital, of Mr. E. S. Roper, chief A.I.D. representative with Short Brothers and Harland, Ltd. He was 56 years old. Before joining Shorts in 1946 Eric Roper had travelled extensively in America as an A.I.D. representative appointed to U.S. factories manufacturing military aircraft and components for Britain. Having served the Directorate since 1924, he had spent tours of duty in most of the leading aircraft factories of the United Kingdom.

VAMPIRES IN GREECE

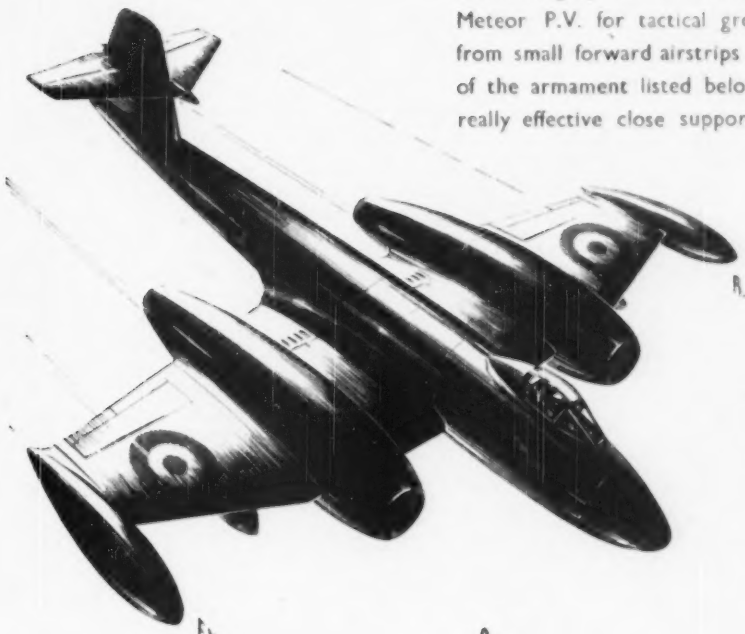
Accompanied by three Valettas, Vampires from a squadron in the Canal Zone recently visited Greece. They flew to Athens, where they were greeted by the Chief of Staff of the Royal Hellenic Air Force, by way of El Adem, Cyrenaica. Citizens of Athens watched formation aerobatics and a formal demonstration was given before King Paul. Before leaving, the squadron was presented with a plaque, and handed over in return a replica of their crest.

Newest Gloster development

GROUND ATTACK ARMAMENT WITH

FULL METEOR PERFORMANCE

With wing-tip tanks R.A.T.O.G., and arrester, this Meteor P.V. for tactical ground attack can operate from small forward airstrips carrying any combination of the armament listed below—essential features for really effective close support.



R.A.T.O.G. & ARRESTER

1000 lb BOMBS

95 lb R.P.s

EXTRA CANNON

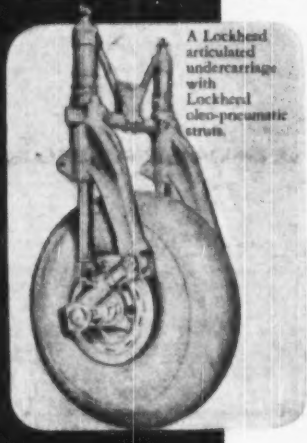
GLOSTER METEOR P.V.

GLOSTER AIRCRAFT COMPANY LIMITED (Member of the Hawker Siddeley Group).

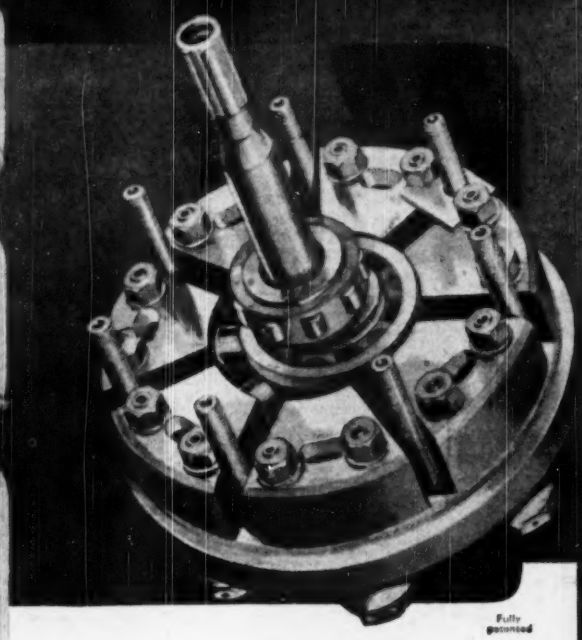
The 'Servodyne' power assistance system for flying controls.

The Lockheed electro-hydraulic selector valve.

A Lockheed oleo-pneumatic shock absorber strut for one of the fastest jet-fighters.



A Lockheed articulated undercarriage with Lockheed oleo-pneumatic struts.



Fully patented

A great British organisation

Lockheed high-precision equipment for aircraft has an outstanding reputation for performance and trouble-free service, and up to the present more than two million units have been supplied.

Among these is the high-precision pump, shown above, which delivers 2½ g.p.m. at 3000 p.s.i. at 3000 r.p.m.: 36,000 of these have been supplied. The Servodyne system, which gives positive and immediate assistance to controls, is another important unit.

ALL-BRITISH

Lockheed

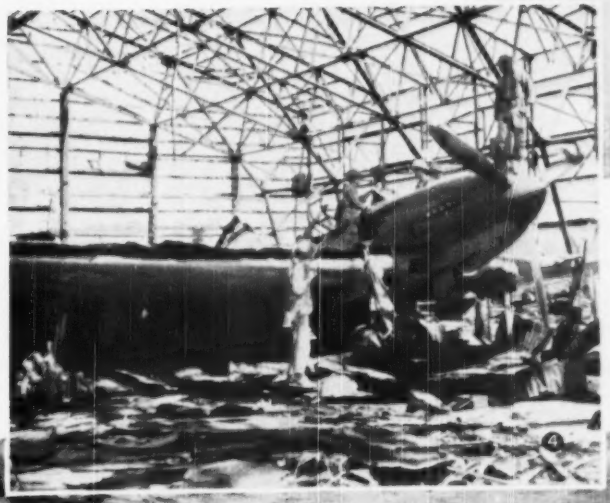
REGD. TRADE MARK

AUTOMOTIVE PRODUCTS CO. LTD.
LEAMINGTON SPA

1

2

3



4

NEWS IN VIEWS

(1) Northrop Black Widow carrying a free-fall model, from which aerodynamic data are telemetered during its supersonic descent.

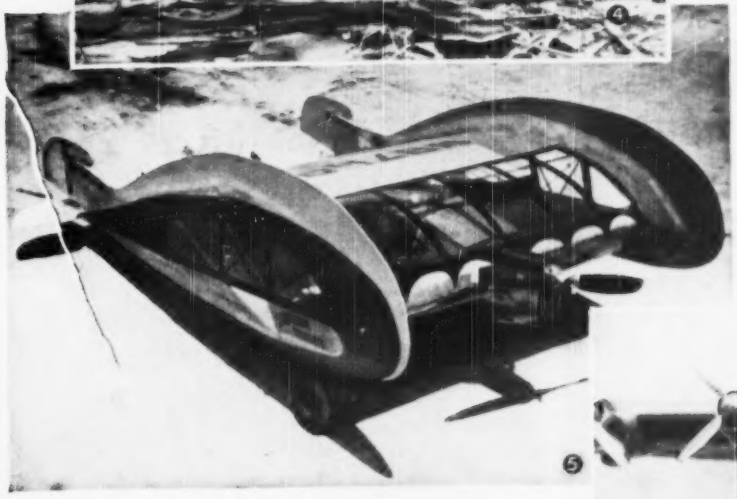
(2) The new two-seat Seibel S-4 (125-h.p. Lycoming) is claimed to be the cheapest helicopter on the U.S. market.

(3) First-flight view of the Sikorsky HO4S utility Naval helicopter (nose-mounted 600-h.p. P. and W. Wasp).

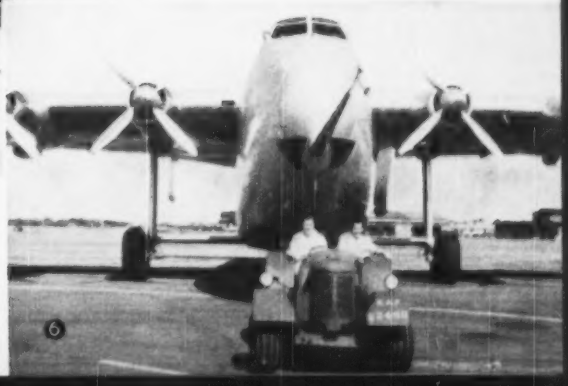
(4) Bearing North Korean markings, this Stormovik was captured by U.S. Marines at Kimpo, S. Korea.

(5) All-wing or wingless ? This experimental American type is now being tested in Florida.

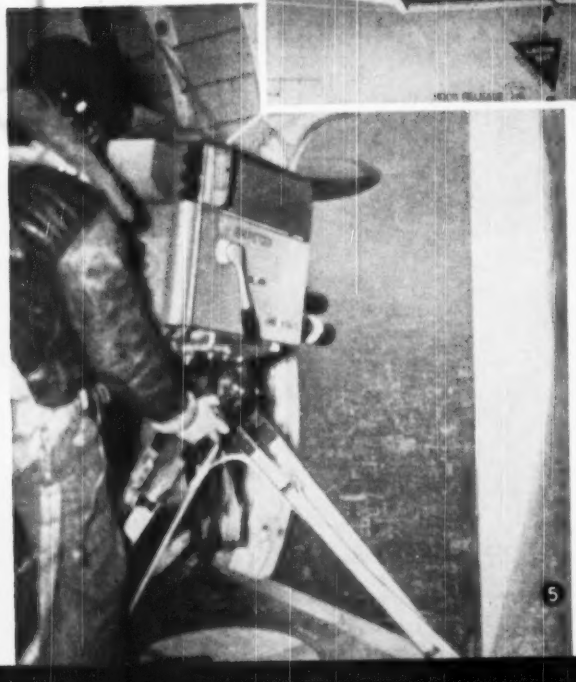
(6) Giant in tow : David Brown tractor hauling the G.A.L.60 Universal Freighter.



5



6



NEWS IN VIEWS

(1) U.S. Naval crewmen reload the 20 mm guns of a Grumman Panther jet fighter aboard a carrier of Task Force 77, off Korea. (2) V. Markov of the Chkalov Central Air Club, who recently captured a 100-km record for Russia at 298 m.p.h. (aircraft unspecified). (3) Concentration : S/L. Tyrie of Bomber Command with his exhibit at the R.A.F. Horticultural Show. (4) Col. Legrand of the Belgian Air Force, who recently collected the first Dutch-built Meteor 8. (5) Behind the scenes: Looking out on London from the Freighter practising for the televising of the capital. (6) A.T.C. cadets, touring America, examine a Mooney Cowboy light aircraft on a Texas airfield.

FIGHTER ARMAMENT

A Lockheed F-80 Shooting Star firing 5-in rocket projectiles from retractable mountings. These R.P.s attain a velocity of 1,350ft/sec and are fired at speeds up to 450 m.p.h. Under favourable conditions eight are carried, in addition to six half-inch guns.

PART III Guns v. Rockets

By A. R. Weyl, A.F.R.Ae.S.

In the first part of this article (August 24th), Mr. Weyl reviewed the history of aircraft armament and showed how lessons of the past had, in his opinion, been neglected by those responsible for developing equipment in the Second World War. In Part II (September 21st) he discussed German equipment, and in the present instalment he analyses the respective claims of guns versus rockets.

AUTOMATICALLY loading and firing arms are about a century old: Bessemer, the metallurgist, designed a self-loading self-firing gun in 1853 but failed to perfect it through lack of a suitable cartridge. It was the firing-pin principle of Dreyse (1860), with its metallic cartridge-case and percussion cap, that provided the technological basis for machine-gun development. Manually driven self-charging, small-calibre guns were at first used, in particular Dr. Gatling's "Death Organ" in the U.S.A., and Montigny's *Mitrailleuse* of the 1870 Franco-Prussian war. Both relied on multiple barrels, and the principles employed have often been "re-invented" since. Another line of development is represented by the drum magazine, single-barrel principle of the Colt-Lefaucheux "revolver."

Hiram Maxim achieved, in 1883, the first practical machine gun: loading, firing, and cartridge-case ejection were actuated by the recoil force produced by the bullet—in other words, this gun was fully automatic. Maxim's principle was that of "short" recoil-travel with mechanically locked breech, a still-favoured method. When the round is fired, barrel and breech-block at first remain interlocked, and move back, reacted upon by the recoil; after a short travel, the barrel, with its breech, is stopped; unlocking takes place, with opening of the breech; then the breech-block alone slides fully back, compressing a return spring. Before the latter returns the breech-block the spent cartridge case is extracted and ejected, and the next round is transported (by some form of Geneva-movement feed) to a position in front of the breech-block. As the block moves forward again, it carries the next round into the breech. The block then locks upon the barrel, and the firing-pin detonates the percussion cap in the cartridge.

Distinct from the Maxim-gun action is the recoil-operated "free blow-back" principle (mass locking as distinct from mechanical locking). The barrel remains stationary and the breech-block alone is pushed back by the recoil. During combustion of the charge, it is solely the inertia of the breech-block which holds the breech closed. This simple action, often with refinements such as toggle joints, is common in automatic pistols; it has also found successful application in air-borne shell guns (e.g., the 20 mm Becker-Hispano, the 20 mm Oerlikon, and the 30 mm German Mk 108*). As "free blow-backs" tend to put more strain on the ammunition, the Germans employed this principle solely in connection with electric cartridge-ignition.

Entirely different is operation by the gas pressure developed in the barrel. The first to use this were E. Lindner (1856) and Poulton (1880). Generally, the gas pressure bled from a hole in the barrel wall—acts upon a piston in a cylinder, against a spring. The piston is connected to the breech-block; it also actuates the ejection and feeding mechanism. Modern air-borne shell guns frequently make use of this principle (e.g., the German 30 mm MG. 213 which forms the basis of a British development).

The "long" recoil principle (barrel and breech-block sliding back together over the whole stroke, with the barrel then separately moving forward to open the breech) has found no general application to modern types of airborne guns.

For air combat, fully automatic weapons alone are practical. For ground attack, however, single-shot (semi-automatic) guns, such as the 75 mm shell-gun on certain bomber variants, and large-bore recoilless guns on certain German aircraft, may have justification.

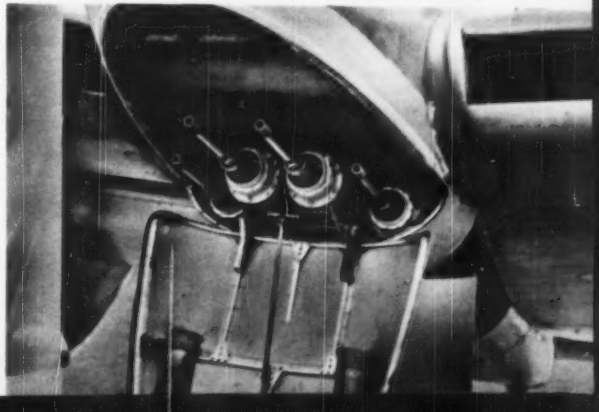
A feeder mechanism transports cartridges at the appropriate moment in front of the breech-block. The single rounds are retained and transported in magazines, drums, clips or belts. For air-combat weapons, belts are now the rule; commonly, they are of metal and of the disintegrating-link type, i.e., separate links are united only by the cartridges, the belt disintegrating at the gun as soon as a feeder claw pulls each cartridge out. A belt implies a continuous feed, but the motion itself is intermittent and in accordance with the rate of fire; this fact introduces special problems. Moreover, with heavier calibres and inertia effects under combat manœuvres, power feeding, either by auxiliary-power-operated belt conveyors or similar devices, is necessary.

All guns have barrels with rifling, i.e., shallow grooves and lands (ridges) in a helical arrangement along the bore, and this serves to impart a spin to the projectile. Smooth-bore guns firing unrotated projectiles have not yet been introduced for air combat. To effect stability of the projectile in flight, rates of rotation of the order of 3,000 r.p.s. are common. Unrotated projectiles need fins.

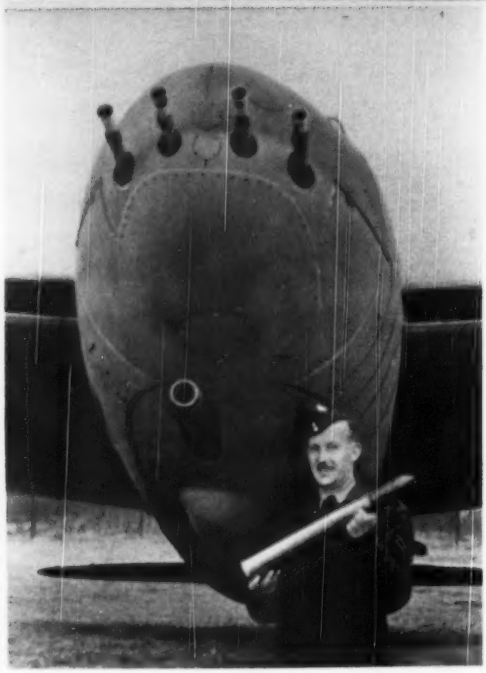
The presence of the rifling naturally complicates the problem of obtaining a satisfactory gas-seal between projectile

The nest of four 20 mm British Hispano guns in the lower fuselage of a de Havilland Hornet long-range fighter. Note how large hinged panels give access to the barrels and breeches.

"Flight" photograph.



* The production of a complete shell-gun of this type required only 75 working hours, including barrel-drawing and rifling.



An adapted 6-pounder (57 mm) anti-tank gun in a D.H. Mosquito F.B.18. A shell for this weapon is displayed, and the auxiliary armament of four 0.303-in Brownings is seen.

FIGHTER ARMAMENT . . .

and barrel. The propellant gases are very hot, of high pressure, and corrosive. Bullets and shells differ in the manner of their sealing. A bullet possesses a resilient outer jacket over a plastic material (usually lead). The jacket, therefore, squeezes itself into the rifling pattern. Shells have bodies of steel, with a driving band of plastic metal shrunk around the steel body; this band rides on the lands and squeezes into the grooves. In the past the material of the driving band was always copper; the Germans have also used sintered iron with good success. When the gas pressures are exceptionally high (muzzle velocities exceeding 4,000 f.p.s.) pre-engraved driving bands may become necessary.

Another solution is the use of an old (1848) device, the *sabot*. This is actually a bullet carrier, or dummy projectile enclosing the rear of a shell; it was originally of wood—hence its name. The *sabot* fills the bore and is of impressionable material to form a gas seal and to impart spin; the shell proper is of substantially smaller calibre. A *sabot* permits the discharge of projectiles of extreme hardness (of tungsten carbide, for instance) and/or shells of section density. After leaving the muzzle, the *sabot* is discarded, usually by disintegration under the centrifugal force of the spin. Related in principle is the 0.5in Pomeroy armour-piercing shell used by the Americans: here the shell detonates and releases a steel core which continues the flight, and which is subject to less drag on account of its slimness. For air combat, the advantages of a *sabot* are doubtful; it can, however, give a flatter trajectory, because of increased section density, without demanding a longer projectile.

Gun muzzles carry flame dampers, blast shields and/or devices either to reduce or to reinforce the recoil. Such reinforcement is occasionally employed to increase the rate of fire of small-calibre machine guns. In shell-guns, however, muzzle brakes (to reduce the recoil loads) prevail. Close to the muzzle, high pressures of hot and corrosive gases may cause an amazing damage to structural parts of the aircraft. In the barrel, the peak pressure may easily exceed 40,000 lb/sq in, i.e., 70 times those experienced in the cylinders of high-performance aircraft engines.

The Automatic Gun as an Internal-combustion Engine.—Thermodynamically, as well as mechanically, an automatic gun is a piston-operated internal-combustion prime mover: the barrel represents the cylinder, and the projectile the piston upon which gas pressure from combustion acts. It is to be noted that the propellant charge is actually *burning* (i.e., not detonating). Instead of transmitting its kinetic energy to a crankshaft, however, the "piston" retains its translatory motion. Thus there is a combustion (expansion) stroke only. The "valve" mechanism, however, operates in two strokes: cartridge-case extraction (and ejection), after "exhaust"; and the feeding of a new round containing the charge and a new "piston," as "intake" action. The combustible fuel/oxygen mixture is introduced into the "cylinder" as solid propellant, with the oxygen contained in chemical affiliation. There is, hence, no need for vaporization and/or mixing.

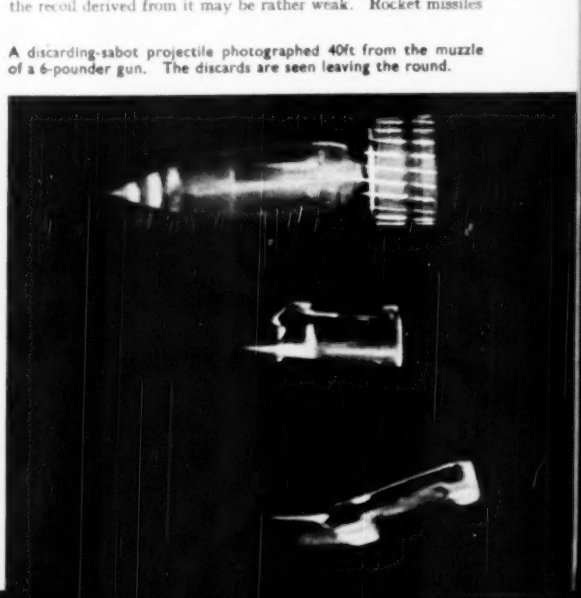
A rifle-calibre machine-gun firing 1,200 rounds per minute actually develops about 80 b.h.p. From the point of weight, a machine gun is, therefore, a very light engine indeed, weighing approximately a quarter of a pound per horse-power only. The consumption is, alas, heavy, because the oxygen is carried in the powder charge, and because the "piston" needs perpetual replacement. Moreover, the power output is not only discontinuous, but of short duration (cooling), and the "engine" is poor in regulation. Due to the great heat developed in the barrel, the creep strength becomes the deciding factor structurally, just as with turbine blades.

The mechanical energy produced by the gun is derived from thermal energy stored in the propellant charge. Weight by weight, the calorific value or heat content of usual nitrocellulose ("smokeless") propellants, e.g., cordite, is low because of the oxygen weight: it is of the order of 870 calories per kilogram (1,600 B.Th.U./lb), whilst petrol produces not less than 11,000 cal/kg (20,000 B.Th.U./lb). Of this heat, 25 to 30 per cent is utilized for acceleration of the projectile; this is higher than that derived from a comparable rocket missile. In a gun, not less than a quarter of the total heat developed is rejected—directly, by radiation and conduction, or indirectly, through barrel friction; and/or it is expended on inducing vibrations. Forty per cent or more of the total heat is lost with the exhausted flame gases, and in producing a sound-wave. The energy required for imparting the spin is small, while recoil absorption, also, forms only a minor part of the heat-energy balance.

Compared with the rocket, the gun is more economical in the exploitation of the heat energy of the propellant: the Hispano Mk. V gun, for instance, has about 28 per cent thermal efficiency, whilst the German R.4/M supersonic rocket missile has but 11 per cent.

The gun propellant charge burns at a high rate (one-ten-thousandth to one-hundred-thousandth of a second). In theory, this burning rate should remain constant with every round fired. Unfortunately, it depends greatly upon the temperature of the propellant *before* ignition; the rate is quicker when the charge is heated before firing, and raised gas pressures are the consequence. Thus, a round which has become heated (in the gun, or due to the sun, or because of storage close to an engine) may not only damage the gun: it leaves the barrel at higher velocity, and consequently has different ballistic characteristics; it also produces higher recoil loads. In the "cease-fire" position, the breech has to open, and no next round must be left in it. This necessarily leads to an unwelcome delay in the trigger response, even when the next round is held ready for insertion into the breech. Also, because this round may have been cooled in flight *via* the open barrel, the recoil derived from it may be rather weak. Rocket missiles

A discarding-sabot projectile photographed 40ft from the muzzle of a 6-pounder gun. The discards are seen leaving the round.



using solid propellants of similar character also suffer from the consequences of temperature sensitivity.

It is not, however, difficult to ensure that all missiles have identical propellant temperatures prior to firing, that this temperature is neither too low nor too high, and that immediate trigger response is retained. Too low a temperature leads to intermittent burning or "chuffing."

A significant difference between gun and rocket propellant is that, in the gun, the burning of the charge should produce maximum gas-pressure shortly before the projectile reaches the muzzle. With a rocket, maximum thrust is desirable immediately after commencement of burning; subsequently, the charge should produce a jet of substantially uniform rate.

Air resistance quickly dissipates the kinetic energy after a shell leaves the barrel. For obvious reasons, all air-combat projectiles should travel at supersonic speeds on their way from the attacker to the target, and short vanes only are required. Hence, there is no need to provide for projectile shapes to give reduced drag at transonic or subsonic velocities, such as the "boat tails" of certain shells. As supersonic drag is high, and because considerations of stability and feeding-stroke prohibit shapes of minimum shock drag, the speed of a shell is quickly expended, and the trajectory described assumes increasing curvature. A well-shaped rifle bullet which starts with 2,900 ft/sec. muzzle velocity has after a 2.4 sec. flight (i.e., at 1,100 yards range) a speed of only 925 ft/sec., its kinetic energy, hence, has dropped to one-tenth of the original figure. Larger-calibre shells sustain a little less loss, on account of greater section density (as the mass increases more quickly with the calibre than does the cross-sectional area); on the other hand, they have less fineness in shape. Since armour-penetration by impact depends so much upon the range, focused blast-energy (by "shaped" charges of high explosive) must be utilized for long-combat ranges or low-velocity guns.

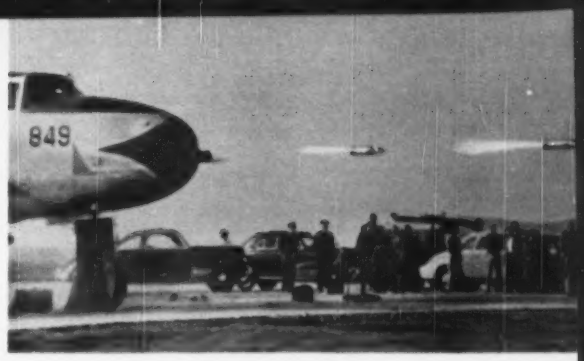
The great rejection of heat to the barrel imposes restraint upon the duration of fire bursts. Fortunately, short bursts are tactically adequate. But barrel erosion under heat also limits the rate of fire. Though there are certain prospects that erosion may be substantially reduced, for the present a multiplicity of guns is necessary to provide the requisite fire density. Experimentally, as much as 2,500 rounds per minute have been achieved from single-barrelled rifle-calibre machine guns.

In interceptor attacks, fire bursts lasting less than 3 sec seem to rule, and 1.5 sec bursts have been recorded during successful engagements. With British installations of eight rifle-calibre guns the aggregate firing time amounted to 25 secs (all guns firing), and this permitted eight to nine full-size bursts. Contemporary Luftwaffe fighters usually had less—perhaps 17 secs total firing time). Present-day British fighters seem to have ammunition sufficient for total firing time of 15 secs. In view of the weight and bulk of more substantial ammunition, the permissible firing time may in future be even more restricted. This emphasizes the need for fully automatic sighting and triggering devices, to exclude all waste of ammunition.

COMPARISON OF MODERN FIGHTER ARMAMENT

	R.4/M Rocket (55 mm)	MK.112 Shell-gun (55 mm)	20 mm Hispano Mk. V
Type of weapon	Supersonic air-to-air rocket	Gas - operated automatic gun	Recoil-operated automatic gun
Gun weight, or weight of launching device	55 lb	608 lb	106 lb
Weight of single round at firing	7.75 lb	5.3 lb	0.925 lb
Projectile weight at impact	5.85 lb	3.27 lb	0.27 lb
Max.trajectorial velocity	1,800 ft/sec	1,970 ft/sec	2,750 ft/sec
H.E. charge per projectile	1.1 lb	0.92 lb	0.022 lb
Rate of fire per gun or launching device	500-600 rounds/min	300 rounds/min	650 rounds/min
Length of weapon	55 in	79.8 in	72.6 in.
Mean recoil force per gun	nil	13,800 lb	3,300 lb
Weights and Performances of a Four-unit Installation, with 60 rounds per gun or launching device, respectively :—			
Complete weight at take-off	2,075 lb	3,475 lb	650 lb
Projectile weight fired	234 lb/sec	65 lb/sec	10.9 lb/sec
H.E. weight fired	75 lb/sec	18.5 lb/sec	0.95 lb/sec
Projectile impact per second, in relation to R.4/M	100 per cent	41 per cent	13 per cent
Installation weight (complete with ammunition), in relation to R.4/M	100 per cent	178 per cent	31 per cent
Hits required for the destruction of a four-engined medium bomber	1	1	20

N.B.—The above data refer to the original version of R.4/M as operationally employed in the spring of 1945.



Heavy "spinner" rockets leaving the nose of a U.S. Navy PBJ (Mitchell) bomber during tests at Inyokern, California.

Rockets for Air Combat.—The history of the rocket-propelled war missile is so ancient that it has been forgotten. War rockets existed even before bright lads tried hollow tree trunks as guns and founded an artillery tradition. Centuries later, unpleasant experience by British forces in India—where sly Tippu Sahib used bamboo tube rockets (Battle of Seringapatam, 1799)—caused an Army engineering officer, William Congreve, to develop large sheet-iron-cased war rockets at Woolwich Arsenal (1804). During the Napoleonic Wars and the American War of Independence (notably, in the Battle of Bladensburg, 1812) these Congreve rockets, launched from ground batteries, special barges and other vessels in amazing quantities, met with such success that most countries copied them. The U.S. national anthem immortalizes a reference to this weapon. From the middle of the nineteenth century, however, the rifled gun began to surpass the simple gunpowder war rocket in performance and accuracy, notwithstanding the introduction of the spinning rocket by William Hale in 1846. Britain employed rockets operationally until 1859 (China and Afghanistan).

Nor are air-to-air rockets a novelty. In 1916, R.N.A.S. fighter squadrons successfully used electrically fired, stick-stabilized Le Prieur incendiary rockets against kite balloons; Capt. Ball and his fellow-pilots even tried them against enemy aeroplanes. Britain, also, built the first intercepter specially designed for rocket weapons—the 200 h.p. Vickers F.B.25 single-seater, to carry the Crayford rocket gun.

All this British experience, also, forgotten by the air-armament experts until the Russians and the Germans rendered evidence that airborne rockets had useful applications. Not until September, 1941, did our officials deign to consider proposals to discharge adapted subsonic A.A.—available in quantity—from aircraft. This was after news had been received of the success of the Russian Stormovik with subsonic rockets against tanks. The gross oversight was the less justified as Woolwich Arsenal had indeed created the basis for modern rocket missiles by accomplishing the dry (i.e., solventless) extrusion of large cordite grains. Moreover, the Army as well as the Navy had conducted many experiments with cordite-propelled A.A. rockets and had introduced weapons of this kind.

Thermodynamically, the rocket is a simple converter of heat energy into velocity energy. A jet produced by high-pressure expanding gas creates a reaction upon the vessel from which it emerges; this is the propulsive thrust. Consequently a rocket consists of a combustion chamber to produce hot gas at high pressure, and a nozzle to convert the pressure into a high-speed gas flow by expansion. In solid-propellant rockets the propellant is stored in the combustion chamber; and as it is self-contained, feeding devices are not necessary. Liquid-propellant rockets have separate containers and feeding devices; the chemical reaction, and thus the thrust, can therefore be accurately regulated during operation. With solid propellants some measure of regulation is possible by means of grain shape and burning inhibition, but it is less easy to achieve with reliability. Also, liquid propellants are less subject to temperature sensitivity.

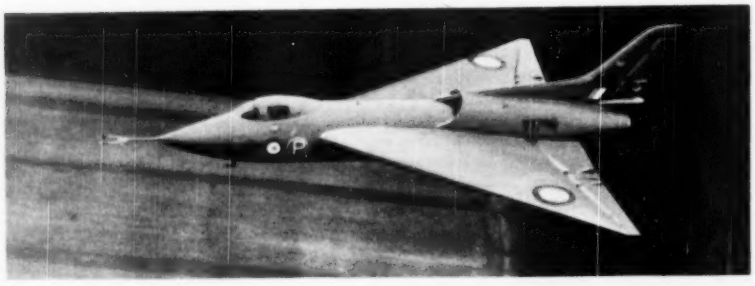
Continued on page 388

"Mighty Mouse" air-to-air R.P.s being test-fired from a Douglas Skyraider. These projectiles have folding fins which automatically extend on firing.

Science and War

Dramatic moment as a Douglas B-26 unleashes a *Tiny Tim*. This massive R.P. is for air-to-ground or air-to-ship use.

Some Recent Pictures Illustrating Co-operative Flight Refuelling, British Aerodynamic Research and Carrier Operation, and American Rocketry



The Avro 707B research aircraft is seen to be remarkable not only for its delta wing but for the location and form of the intake to the Rolls-Royce Derwent turbojet. The housing for the anti-spin-cum-braking parachute is visible beneath the rudder.

A de Havilland Sea Hornet N.F.21, with flaps lowered, dropping despatches aboard the light fleet carrier H.M.S. *Vengeance* as the vessel proceeded to Gibraltar to joint the recent Home Fleet exercise.

East African Seaboard Defence

When the integration of the defence of British and French Territories is discussed, the importance of long range land based aircraft will not be overlooked. Operating from Mombasa and other key points, Avro Shackletons could sweep an area from the Red Sea to the Union of South Africa carrying devastating offensive armament and the most up-to-date radio and radar equipment

AVRO

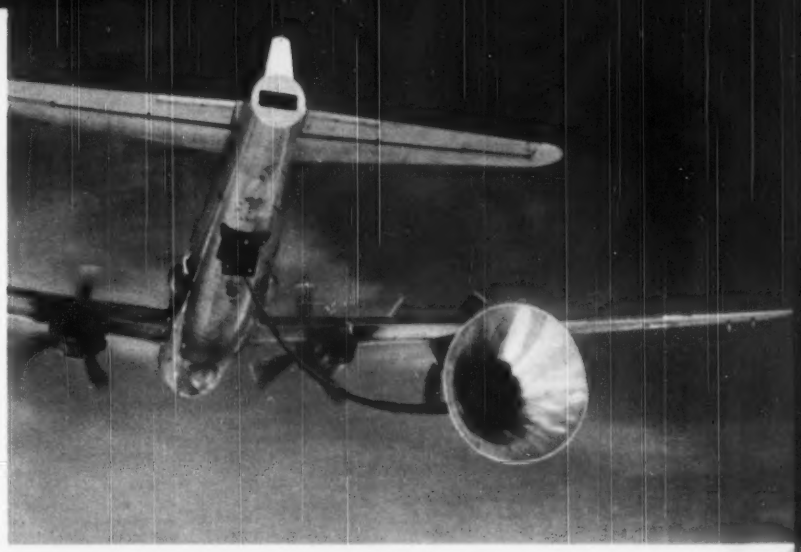
Shackleton

A V ROE & CO LTD MANCHESTER *Member of the Hawker Siddeley Group.*

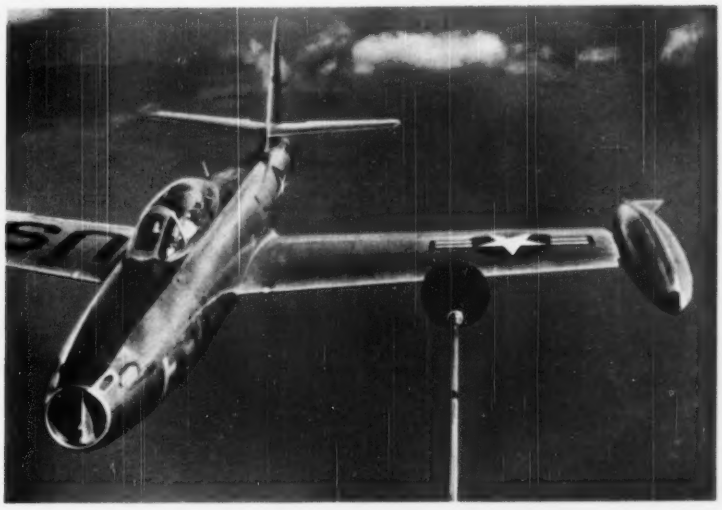
Training in a fine tradition

DE HAVILLAND CHIPMUNK

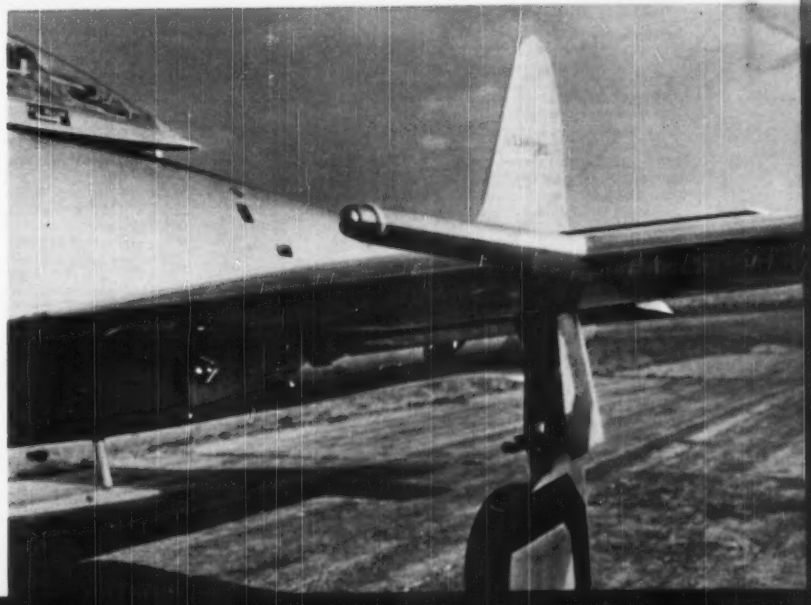
Gipsy Major engine



The Flight Refuelling hose and drogue, trailing from a Boeing B-29 tanker, as it might be seen by a pilot closing in to replenish the tanks of his jet fighter. Both Lincoln and B-29 tankers have been used for recent flight-refuelling experiments in this country.



A Republic F-84 Thunderjet fighter of the U.S.A.F. in contact with the tanker. The hose is seen feeding the fighter's tanks through a wing-mounted probe, illustrated below.



This close-up of the Thunderjet's refuelling probe shows that this, the only necessary excrescence on the fighter, is of low drag. There appears to be no reason why, in future fighter designs, the probe should not be made retractable.

NATIONS AND AIRWAYS

Towards a Truly International Outlook: Sir George Cribbett's R.Ae.S. British Commonwealth and Empire Lecture

Sir George Cribbett.

BEFORE the Royal Aeronautical Society last Thursday, September 28th, Sir George Cribbett, K.B.E., C.M.G., Deputy Secretary of the Ministry of Civil Aviation, delivered the sixth British Commonwealth and Empire Lecture, under the title *Some International Aspects of Air Transport*. The principal sections of the paper are given, in slightly condensed form, below.

Sir George confined himself to particular features of international relationships in air transport arising in the economic field. It was, he said, in this field—of rights to pick up and set down traffic, and rates of carriage, subsidies and so on—rather than in the technical and legal fields, that the reconciliation of divergent national views, or the failure to reconcile them, would have the most profound effect on the future development of international air transport. Considerable progress had already been made through the medium of I.C.A.O., established by the Chicago Convention, in securing the multilateral adoption of technical standards and practices which governed the safety of aircraft in operation. The attainment of international objectives in the technical field was in sight, but uniformity of approach, and multilateralism in the economic field, continued to elude their most ardent supporters.

International relations in air transport attracted less attention and interest—certainly in Great Britain—than did the organization and operation of our national air transport services. Yet air transport was, by hypothesis, an international economic activity in which every country of standing was either participating or intending to participate. Consequently, the basic policies, laws and principles now being evolved by the nations of the world must have a determinative influence on the pace and scope of the future development of international air transport. This was a suitable stage, therefore, at which to analyse and review the effects of policies and principles which had influenced post war air transport development, and to consider future trends.

We were deeply committed to the acceptance of certain basic conceptions which, through a series of international conferences and bilateral agreements, had almost become basic laws of international air transport, deeply enshrined in the thinking of all countries now members of I.C.A.O. The doctrine of the freedoms of the air, with its far-reaching implications, the principle of reciprocity in the exchange of commercial rights, the principle of internationally agreed fares and freight rates as a basis of international competition on scheduled air services, had all become firmly established in the post-war approach. It was important to realize that there could be no turning back of the clock on these fundamentals, which governed the approaches of all countries to their international relations in air transport. Only the complete failure of these basic laws to survive the test of experience would lead to their abandonment or supersession. For better or worse, the future course of events in international air transport, so far as the lecturer dared predict, seemed likely to stem from certain now-established concepts.

The particular features of international air transport on which he would concentrate were: (a) exchange of rights of commercial operation—the multilateral and bilateral approaches; (b) the importance and control of regulated fares, freight rates and mail rates; (c) subsidies. Of these, the main emphasis would be laid upon the first, but some mention of the other two features was necessary to complete the perspective.

Sir George embarked on his study with an examination of the exchange of rights of commercial operation. After considering the pre-1939 period, he went on to deal with the wartime and post-war phase, during which the United Kingdom had turned towards the doctrine of "the freedoms of the air" which had since secured world-wide acceptance as a basic condition of the exchange of commercial rights. A contemporary official document stated that the maximum of co-operation and the elimination of uneconomic competition must involve consideration of the conception of the freedom of the air, which ought not to mean that the aircraft of any country could fly anywhere without any kind of restriction. It ought to mean, stated this document, that those countries and aircraft which were prepared to observe certain principles agreed internationally should not be prevented by other countries from enjoying certain minimum rights essential to operation. The document stated that freedom of the air was an undefined term and was variously interpreted as including: (1) The right of innocent passage. (2) The right to land for non-traffic purposes (e.g., refuelling, repair, emergency). (3) The right to land passengers, mails and freight *embarked* in the country of origin of the aircraft. (4) The right to embark passengers, mails and freight *destined* for the country of origin of the aircraft. (5) The right to convey passengers, mails and freight between two countries, neither being the country of origin of the aircraft. (6) The right to convey passengers, mails and freight between two points in any one country not being the country of origin of the aircraft.

The "Freedoms"

Here we had the birth of the analysis of the "freedom of the air" which gave rise to the Five Freedoms as we knew them to-day, and as they appeared in practically all international agreements. The Sixth Freedom described cabotage, which almost every country reserved to its own airlines—and it was commonly known as cabotage rather than the Sixth Freedom. With the permission of the author, Mr. Peter Masefield, a graphic illustration [reproduced here] of the "Freedoms" was annexed to the Paper.

It was generally recognized, continued Sir George, that the right to pick up and set down traffic, embraced by Freedoms Three, Four and Five, would be conditional on the formulation of satisfactory machinery for regulating competition, but opinion was divided whether the non-traffic Freedoms (One and Two) could be conceded unconditionally. The question was of considerable importance to the United Kingdom, with its far-flung Colonial territories. Many of these territories lay athwart the main trunk routes of the world and were necessary staging points for international airline operation. Consequently they had an important economic value, even though they did not give rise to rights to pick up and set down traffic. The general conclusion was reached, however, that if general support were forthcoming for satisfactory principles of international co-operation, these rights should be exchanged multilaterally and unconditionally.

United Kingdom policy towards international air transport was crystallized and presented in a White Paper of October, 1944, on the eve of the Chicago Conference. It had often been said by commentators on this policy, both at home and abroad, that it was dictated by the desire to secure a measure of protection for British air transport during the period of post-war rehabilitation. The policy, however, was entirely objective and was designed to secure orderly development of international air transport and to prevent a relapse into the

chaotic pre-war conditions which had become a matter of concern to many civil aviation administrations, particularly in Europe, before the war.

The lecturer went on to survey the Chicago Conference of 1944, the Bermuda Agreement, the Multilateral Commission of I.C.A.O. (meeting at Geneva in 1947), and the post-Geneva situation. Attempts to secure a multilateral agreement for the exchange of commercial rights having failed on the vexed issue of the exercise of the Fifth Freedom, the routeing of international air transport services and the nature of the commercial rights to be exercised on the routes continued to be governed by bilateral exchanges. The United Kingdom, in their negotiations with other countries, endeavoured to conform to the essential features of the Bermuda Agreement pattern in the belief that this type of agreement was the best yet evolved to give practical expression to a policy of progressive expansion in international air transport, while holding the balance between the needs of the public, both for long-distance air transport and for local and regional services. The loss of flexibility, which was inherent in bilateralism, was aggravated by the growth of national policies of self-protection, which led to restrictions both on the routeing of the services and on the grant of Fifth Freedom rights on long-distance operations. Just as every country with a seaboard sought to play a part in international shipping after the First World War, so every country of substance decided to develop its air transport following the Second World War. Over 50 countries (excluding dependent territories) were now engaged in international air-transport operation.

It must now be evident from the experience of the past five years that international air transport had not yet reached a stage of economic self-sufficiency and that many countries could obtain the benefits of air transport at far less cost to their taxpayers if they relied upon the services of those countries which were far better equipped technically and economically to provide them as part of wider systems of development. It was wishful thinking, however, to expect a country, once committed to participate in air-transport development, to subordinate national prestige to the natural laws of economics. Consequently, national prestige, with its corollary of reciprocal rights for any rights granted, dominated (as it did before the 1939-45 war) this phase in the evolution.

The phase was bedevilled by two main factors, namely (i) the failure of air traffic to live up to expectations of progressive post-war expansion. There had been substantial expansion, but even the more conservative prophets had underrated the persistence of the war aftermath with its legacy of unsettled world conditions, currency restrictions and rising costs. (ii) The determination of practically all sovereign powers to participate in international air transport. This had led to the provision of capacity to meet a traffic demand which present world economic conditions and current levels of fares and rates for other traffics could not sustain.

Limitations to Progress

Some of these problems were temporary. The traffic potential was susceptible of great expansion, both by the creation of new classes of traffic, which air transport would generate, and by transfer from other forms of transport. To-day less than 20 per cent of the yearly traffic moving between the United Kingdom and France travelled by air. Whatever differences of opinion existed about the relative attractions and consequent patronage of air and sea travel on the North Atlantic, it was inconceivable that the physical and other advantages of air travel over surface transport between the United Kingdom and the Continent would not ultimately secure to the air a much greater share of this traffic. The limiting factors, at present, were fare levels and a public which had not yet become air-minded. But with the design of aircraft of progressively improving economic performances, and with a rising generation attuned to the air age, these limiting factors would be steadily removed. Given a period of stability and freedom from war, it was reasonable to assume a progressive improvement and the removal of existing restraints.

Meanwhile, we had with us the interim problems of a sluggish traffic potential, too many competing interests, and conditions of economic abnormality. Hence, the growth of national self-protection on the part of countries which had not yet established themselves in international air transport. The influence of national airlines on their Governments in pursuing protective policies was becoming clearly discernible. It was natural that airlines, charged with the difficult task of justifying their commercial results in this highly competitive field, would strive for protection, but Governments, in the discharge of their wider policy responsibilities for promoting efficient and economical expansion of international air transport, must retain a proper perspective and be on their guard against the erection of barriers to defend inefficiency. Extreme protectionism and unreasonable restrictions on the exercise of commercial rights would retard the expansion which, itself, could set in motion the continuing cycle of reducing costs and fares and the consequent growth of the traffic demand.

The economics of international air-transport development and the purses of national exchequers would be severely strained during the next few years unless insistence on the principle of reciprocity—which normally took the practical form of expensive competition between independent national airlines operating in parallel over the routes which joined their territories—could be tempered by some form of rationalisation. It might be that the trend towards closer international economic co-operation in other fields would find its reflection in air transport, but national sovereignty and national prestige considerations still exerted a profound influence towards independence in this field.

Sir George proceeded to review forms of Commonwealth co-operation before turning to fares, freight rates and mail rates, and considering United Kingdom policy and the formation of I.A.T.A. and its functions as a rate-fixing body. He said that in discharging its paramount responsibility for securing agreed rates (which necessarily involved careful co-ordination of rate resolutions on a world-wide basis), I.A.T.A. should be on its guard against the inherent danger of rigidity and lack of flexibility in its rate structure. Considerable progress had been made with the introduction of sub-standard rates; nevertheless, there seemed to be scope for greater elasticity in fixing rates to meet conditions peculiar to certain areas, or circumstances, in which there was a public demand which could not be satisfied adequately within the existing rate structure.

Air-mail Rates

Turning to air-mail conveyance rates, the lecturer pointed out that, as the history of the pre-war International Air Traffic Association and the more recent experience of the present I.A.T.A. would show, airlines from the beginning had experienced the greatest difficulty in securing recognition of the value of the service which air transport could render in the carriage of mails, especially on long-distance services. National postal administrations naturally sought to offer their services to the public at the cheapest possible rate. There was the dual incentive of efficiency of the postal service and service to the nation in facilitating trade and other relationships. Transport charges obviously exerted a preponderant influence on postage rates and it was in the interests of postal administrations to obtain the lowest possible rates for conveyance of mails. Nationally, through the monopolies they enjoyed and, internationally, through the Universal Postal Union, postal administrations were in a powerful bargaining position. Airline operators, on the other hand, recognized the importance of the speed they had to offer. Its value obviously increased with distance. The airline operator therefore claimed a rate commensurate with the value of the service he had to offer.

Widely different conclusions on a reasonable commercial rate for conveyance of mails could result from these differing approaches. Most postal administrations opposed the payment of rates for mails which contained any element of subsidy to other forms of traffic. Although they recognized that current passenger fares and freight rates were below airline profit-levels and would not, therefore, be a reasonable basis for air mails, they considered that, in order to avoid any subsidy element, payment for mails should bear some relationship to costs of operation, plus a margin of profit. The airline operator, for his part, claimed the right to a rate based, as were his passenger and freight rates, on the charge the user was able and willing to bear. He claimed that the principle of differential rates was well established in industry, including other transport industries. In any industry where more than one commodity or service was produced by a single process, the general practice was to fix prices for each product by reference to the marketable value to the consumer in such a way as to ensure that the overall return at least covered total costs. The airline operator held that the application of these well-recognized commercial principles to air traffic would clearly justify much higher rates for mails, without importing any suggestion of subsidy to other forms of traffic. Mails, more than other classes of traffic, benefited from air transport; revenue from them was widely diffused in its incidence on the public, and the letter writer, in return for a modest charge, secured in far greater measure than the individual passenger or consignor of freight the benefits of air transport. So ran the argument of the airline operator for a rate which, even though it might yield a profit, contained no element of subsidy.

These differing viewpoints had been resolved, by compro-

NATIONS AND AIRWAYS . . .

mise, in settling the rates which a postal administration should pay for mails conveyed by a foreign airline. These rates were settled between the Universal Postal Union and the I.A.T.A. The two bodies had agreed that administrations using the services of a foreign operator should pay a rate of three gold francs a tonne-kilometre for short-haul services, e.g., intra-European services, and six gold francs a tonne-kilometre for long-haul services. It is true that these rates were regarded by the U.P.U. as maxima and by I.A.T.A. as minima, but they were applied in practice as the standard rates for carriage of mails by foreign operators. The agreement, however, did not extend to the rates to be paid by a postal administration to its national airlines. With few exceptions, administrations paid rates below the "international" level to the airlines of their own country.

Existing United States national policy, however, was far-sighted and appeared to recognize that the user of air mail, as the greatest beneficiary from air transport, could contribute to its development in order to secure the long-term objective of cheaper rates without bearing an undue share in the present. Under the Civil Aeronautics Act, 1938, the Post Office Department was established as the fiscal instrument for the encouragement and development of a satisfactory air-transport system. It directed the Civil Aeronautics Board to consider "the need for each . . . air carrier for compensation . . . sufficient . . . to enable such carrier under honest economical and efficient management to maintain and continue the development of air transportation to the extent and of the character and quality required for the commerce of the United States, the Postal Service and the national defence." Thus, given honest, economical and efficient operations, the United States airline operators' short-fall of revenue from passengers and freight was provided from mail revenues at the disposal of the Postal Department. Admittedly there was some element of subsidy in these balancing payments from mail revenues but, unless these air-transport "need" payments by the Postal Department exceeded mail revenues, the incidence of that subsidy fell on the vast public which used the air mail system, rather than on the general public which contributed to the national taxation system. (The lecturer added that a change of United States policy, which would divorce subsidy from air mail payments and revenues, had recently been approved by the President for legislative action.) Whatever might be the merits of a subsidy to air transport contributed by air-mail revenues, as opposed to a straight Exchequer subsidy unrelated to any particular source of revenue, there was certainly an arguable case, in the interests of air-transport development, for remunerating airline operators at rates not less than those internationally agreed between the U.P.U. and I.A.T.A., without importing any element of subsidy or imposing unreasonable charges on the user.

"All-up" Mails

On the merits of the international rates of three gold francs and six gold francs a tonne-kilometre, the wide differential was scarcely justified by the relatively small differences in costs of short-haul and long-haul operations. Bearing in mind that national policies were inclined to favour the national operator, mail traffic tended to be one-way and to be unmatched by return loads. The airline, therefore, had to face the unproductive costs of unfilled capacity in one direction. The lower rate of three gold francs could only be justified by the "all-up" system, under which all first-class mails were carried by air. All-up systems which left the user without surface transport option must necessarily avoid high postage rates, and airline operators must depend for their revenues on narrower profit-margins on heavier loads. As experience of the Empire Air Mail Scheme had taught the Commonwealth, the all-up principle was not satisfactory to the long-distance operator, who did not possess the aircraft flexibility of the high-frequency short-haul operator in dealing with mail-traffic peaks which, under the Empire Air Mail Scheme, occurred particularly at week-ends and at certain seasons. Thus, while there were formidable practical objections to substituting all-up for surcharged mails on long-distance routes, the all-up system had been found workable on intra-European routes. But the yields to the short-haul operator at existing rates were small in relation to the return capacity he employed, and did not seem to recognize sufficiently the useful part air mails could legitimately be expected to play under any forward-looking policy of air transport development. Postage surcharges on long-distance air mails, which secured the maximum benefits of air-transport acceleration, without depriving the user of his option of cheaper and slower surface transport conveyance, might be so fixed as to produce the revenues necessary to improve somewhat the lower international rates of three gold francs for the short-haul operator.

The twin-rate mail structure as such had the merit of simplicity and did not seem open to serious objection, but the differential might be narrowed by increase of the lower rate.

Turning to subsidies, Sir George Cribbett pointed out that a continuance of present trends indicated the possibility of progressive reduction of direct subsidy payments to airlines. Whether it was the right course to aim at the entire elimination of direct subsidies, before any attempt was made to secure increased contributions towards airfield and ground-organization facilities, was a question on which opinions would differ. The direct subsidy had well-recognized drawbacks. It might act as a brake on initiative, enterprise and resourcefulness; it might cloak inefficiency; it might, unless watched by Governments, lead to reductions in fare levels at a faster pace than economic considerations would justify; and it might provide a convenient medium for concealment of competitive subterfuges designed to gain unfair advantages. So long as international air transport required direct subsidy support there was no reliable yardstick of national rates of subsidy necessary to support an efficient industry in its present stage of evolution. Consequently, the measure of the subsidies attributable to other causes, including considerations of national policies, remain obscured. It might have a salutary effect on Governments if they had a more exact measure of the cost to them of any national policies which might influence their participation in international air transport. These were arguments which seemed to point to concentration first on the elimination of forms of subsidy involving direct payments to airlines.

But there were counter-arguments to such unqualified priority of treatment to be considered. Indirect assistance in some of its forms might be equally open to some of the foregoing objections. The main form of indirect assistance—through the airfield and ground organization—had the merit of being non-discriminatory in its incidence between international airlines and did not provide a medium for competitive abuses, if the conditions of the Chicago Convention were scrupulously observed. Nevertheless, a form of assistance which was only reflected in the national budget, and not in the profit-and-loss account of the airline, was apt to create an illusory appearance of successful progress towards self-sufficiency in the industry. In such circumstances it was not unnatural that airlines, through I.A.T.A., would tend to adopt rates of carriage which would fail to take adequate account of the contribution the air-transport user could legitimately be expected to bear, as operators' costs declined, in meeting increased airfield charges in relief of present burdens.

Unilateral Action

Governments, in the exercise of their rights of approval of I.A.T.A. recommendations, could in theory exercise the necessary measure of control over rates of carriage to take account of airfield charges. In practice, governments acted individually, and not collectively, on the Rate Resolutions of I.A.T.A. and until policies of governments had been co-ordinated in dealing with this important form of indirect assistance, effective government action to deal with the provision to be made for airfield charges, as part of the rate-fixing process, was not possible.

The I.C.A.O. organization, as the instrument of governments, had embarked upon a study of these problems and would no doubt propound solutions to its members. Meanwhile, individual governments had the task of deciding their own courses of action. Whatever might be the apparent advantages of first eliminating subsidies in the form of direct payments to airlines, it seemed clear that indirect assistance, where it was of considerable magnitude, created problems requiring concurrent solution.

A useful guiding principle, in deciding the timing and amount of increases of airfield charges, was the measure of contribution the traffic would bear without arresting the legitimate expansion of the industry. Current rates of landing fees amounted, typically, to three per cent of the revenues of a long-distance airline. In Sir George's personal opinion the doubling of this relatively small percentage would make a material contribution to airfield revenues, and if the opportunity were taken to synchronize increases of landing fees with proposed reductions of fares and freight rates, so that the former represented only a modest percentage of the latter, neither the individual user nor the progress of the industry need be adversely affected.

It had now become evident that international air transport would have an increasingly important part to play in world communications systems. One might perhaps regard subsidization as the forcing-house of latest self-sufficiency in air transport, but in an industry in which the ability to expand by its

The new H.P.R.2 training aircraft fitted with the Alvis Leonides engine

ALVIS

LEONIDES

ALVIS LIMITED, COVENTRY, ENGLAND

AIRWORK
LIMITED
Charter Division

Another job for Airwork!

Airwork Contract Charter aircraft operate over most of the world, flying personnel, valuable, urgent and perishable cargoes with speed and certainty. Charter Flying is but one aspect of Airwork, the greatest private enterprise air organisation of its kind.

Rare white rhinoceroses being transported by Airwork Limited "DAKOTA" from the Khartoum Game Reserve to Antwerp Zoo.

THE SERVICES OF AIRWORK

Air Transport Contracting • Servicing and Maintenance of Aircraft
Overhaul and Modification of Aircraft • Sale and Purchase of Aircraft • Operation and Management of Flying Schools and Clubs • Radio Sales and Service • Insurance

AIRWORK LIMITED 15 CHESTERFIELD STREET LONDON W.1 TEL GROSVENOR 4841

Also at: Gatwick Airport, Horley, Surrey; Blackbushe Airport, Nr. Camberley, Surrey; Langley Aerodrome, Bucks; Stapleford Aerodrome, Herts; Loughborough Aerodrome, Shelthorpe, Leics.; Rhoose Aerodrome, Rhoose, Nr. Barry, Glamorgan; Penrhos Aerodrome, Pwllheli, Carns.; Haverfordwest Aerodrome, Castlemartin, Co. Pembroke; Perth Aerodrome, Perthshire; Usworth Aerodrome, Washington, Co. Durham.

NATIONS AND AIRWAYS . . .

own efforts was becoming increasingly apparent, the acceleration of its expansion with State assistance must be related to the measure of support it was reasonable to call upon the taxpayer to provide.

Sir George distilled the main features of his lecture into the following summary of conclusions: —

(1.) The nature of rights to carry traffic, at present secured through inter-governmental bilateral Agreements, exercises a profound influence on international air transport. The governing doctrine of the Five Freedoms of the air and associated regulation of capacity which may be offered on international routes have become firmly established in all national policies. Although successive attempts to achieve a form of multilateral code, based on sound principles of orderly development, have failed, the expansion which awaits international air transport will be retarded until enlightened multilateral co-operation can be achieved. This is unlikely in the near future, owing to the existence of widely divergent national views.

(2.) Considerations of national prestige and defence, already pronounced features of the inter-war years, continue to dominate international relationships in air transport and have produced the firmly established principle of reciprocity, which normally expresses itself in the form of competitive parallel operations between the territories of the parties to bilateral Agreements. Among the consequences are: (a) The defeat of multilateralism and survival of bilateralism as the instrument for exchange of routes and traffic rights; (b) Wasteful duplication of effort on many routes, irrespective of traffic justifications; (c) Increasing growth of policies of self-protection and consequent restrictions on the grant of routes and traffic rights; (d) Self-protection and restrictions have placed a premium on efficiency, have retarded expansion and led to subsidization beyond the needs of efficient development of a new industry.

(3.) The inherent difficulties of bilateralism, accompanied by reciprocity and restrictive policies, have been aggravated by the failure of post-war traffic to live up to expectations of expansion. Among the causes are unsettled world conditions, currency restrictions and rising costs.

(4.) The Bermuda-type agreement is the best yet evolved to meet conditions of competing reciprocal operation. It is flexible, holds the balance fairly between competing interests, promotes expansion and rewards efficiency within controlled limits.

A Saner Approach

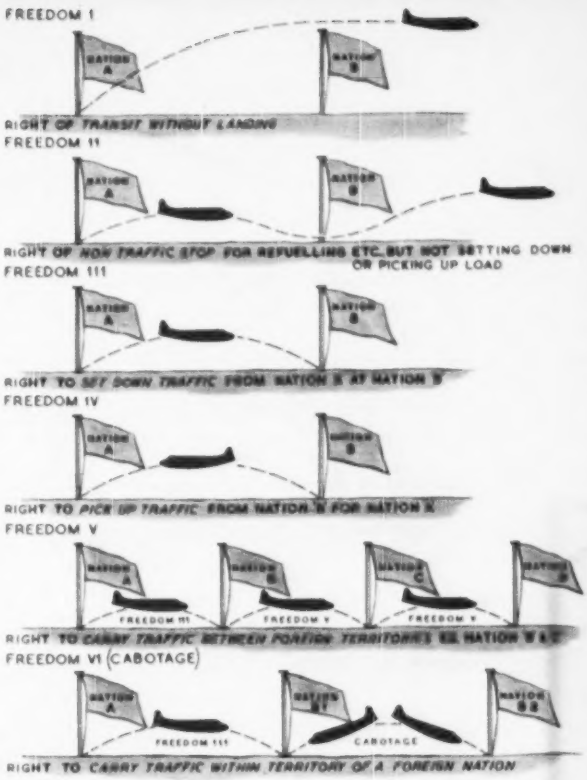
(5.) During the difficult years immediately ahead the growth of air transport might be assisted by the extension, where feasible and beneficial, of forms of co-operation already in operation in the Commonwealth, namely, joint ownership and operation, parallel partnership form of "pooling" operations and rationalization by division of routes between operators, according to resources and responsibilities. Constructive measures of co-operation provide a saner approach than self-protection and restrictions which stultify development.

(6.) The policy of the agreed rates of carriage is one of the major post-war advances in securing orderly development of international air transport. I.A.T.A. has already a remarkable record of achievement to its credit but greater flexibility in its rate structure seems possible in the interests of traffic promotion. Governments can also improve the effectiveness of the work of I.A.T.A. by accelerating their decisions on Rate Resolutions.

(7.) Further considerations should be given to the question whether air-mail rates cannot legitimately be expected to make a greater contribution to air transport development, without importing any suggestion of subsidy to other forms of traffic or charging the air-mail user a postage rate not justified by the benefits of the service rendered.

(8.) There is evidence of a declining trend over the past 20 years in the rate of subsidies paid to airlines in terms of output. This trend should continue, given economic rates of carriage, the abatement of policies of self-protection and restriction and improving traffics, but the need for greater contributions to the cost of the ground organization should be recognized as reductions in rates of carriage become possible.

The problems we faced in air transport today, the lecturer concluded, reflected a world of rapid social changes, technical advances and political upheavals and conflicts. Air transport was symbolic of the era: it made its own contribution to the shifting scene of social and economic changes and, in its own development, presented many of the transitional problems of the changing order. The conservative mind instinctively recoiled from change. The zealot grasped it with ebullient enthusiasm, often blind to its obstacles and problems. In air transport we should cultivate a resolute and sober optimism which blended imaginative enthusiasm with realism born of experience. We should face our problems in a spirit of challenge to the future and in the conviction that, with faith and determination, we could foster and consolidate a great international enterprise whose boundaries are the limitless horizons of the air.



The Freedoms of the Air, as related to a hypothetical aircraft operated by Nation "A." (Mr. Peter Masefield's illustration.)

FORTHCOMING EVENTS

Oct. 6 West London Aviation Club: Film Show.
Oct. 11 R.Ae.S. (Brough): "The Mamba Engine," by J. Marlow.
Oct. 21 Helicopter Association: "Helicopter Maintenance"—discussion with S.L.A.E.
Oct. 24 R.Ae.S. Section Lecture: "Aircraft Riveting," by H. Giddings, A.F.R.Ae.S.
Oct. 26 R.Ae.S. Graduates: "Compressor and Turbine Cascades," by J. A. Dunsby, B.Sc., D.I.C., Grad.R.Ae.S.
Nov. 7 R.Ae.S.: "Aircraft Metallic Materials at Low Temperatures," by Maj. P. L. Teed, A.R.S.M., M.I.M.M., F.R.Ae.S. (at Belfast).
Nov. 8 Royal United Service Institution: "Aircraft Requirements of the Navy," by Vice-Admiral M. J. Mansergh, C.B., C.B.E.
Nov. 9 R.Ae.S. Graduates: "Work in the High-speed Tunnel," by F. G. Irving, B.Eng., Grad.R.Ae.S.
Nov. 14 R.Ae.S. Section Lecture: "Operational Problems of Public transport Helicopters," by R. H. Whitby, B.Sc., A.R.C.S., D.I.C., A.F.R.Ae.S.
Nov. 15 R.Ae.S. (Brough): "The Role of Aircraft in Future Warfare," by Air Marshal Sir Robert Saundby, K.B.E., C.B., M.C., D.F.C., A.F.C.
Nov. 23 R.Ae.S.: "Rockets and Assisted Take-off," by A.V. Cleaver, A.R.Ae.S.
Nov. 25 Helicopter Association: "Helicopter Piloting," by J. S. Fay.
Nov. 28 R.Ae.S. Section Lecture: "Metal Adhesive Processes," by F. M. Parker.
Dec. 6 R.Ae.S. (Brough): Members' Lecturettes, and Film Show.

1951

Jan. 10 R.Ae.S. (Brough): "High-speed Flight," by H. Davies, M.Sc., F.R.Ae.S.
Feb. 14 R.Ae.S. (Brough): "Aero Engines," by Air Cdre. F. R. Banks, C.B., O.B.E.
Mar. 14 R.Ae.S. (Brough): "Aircraft Structures," by P. B. Walker, M.A., Ph.D., F.R.Ae.S.
Sept. 11-17 R.Ae.S. and I.Ae.S.: Third Anglo-American Aeronautical Conference, Brighton.

FIGHTER ARMAMENT . . .

Continued from page 381

Basically, most solid propellants are similar to the propellant charges in guns; commonly, they are double-base nitrocellulose smokeless powders. The major difference is in the shape of the grain, i.e., the form of the compressed solid propellant. Rockets have longer burning-times than gun charges, and the necessary precautions to prevent irregularities in the burning require special powder compositions and much technological development.

In the future of air combat, there seems no likelihood of checking the trend towards projectiles of larger calibre and more powerful action. There is little probability of the development of explosives of greater effect. The trend to calibre-increase brings the shell into competition with the rocket. It may also open the field for a combination—as, for instance, the rocket-thrust-assisted shell and the athodyd shell.

The problem is, at what calibre or projectile weight the rocket begins to offer better prospects. From German development work, it would seem that at a calibre of 50 mm. (2in) the rocket is already superior to the shell. A shell could, of course, possess nearly twice the muzzle velocity of the maximum velocity of a present-day rocket: but the gun to fire such shell would, at 50 mm. calibre, be of formidable size and require an interceptor or medium-bomber dimensions to carry it; besides, the rate of fire would be necessarily low. A rocket of this calibre can be fired from any present-day intercepter, however small, and restricted in armament weight or bulk.

The rocket has no basic restriction as to rate of fire. Multiple salvoes are indeed practical and were about to be operationally introduced by the Luftwaffe. The Natter rocket-propelled intercepter, for instance, was to fire no fewer than 33 R.4/M missiles simultaneously. German automatic launchers dispatching these missiles at a rate of 600 per minute have already been mentioned. Such amazing fire density with large-calibre missiles compensates to some extent for the greater dispersion which still afflicts supersonic rockets.

For primary action by blast, the rocket is distinctly of advantage. It can have low section density, i.e., more of the projectile weight can be invested in high explosive. Moreover, the far slower acceleration of a rocket permits it to carry types of high explosive which would not be barrel-safe in a gun. The same applies to fuzes and detonators. Highly-sensitive instantaneous fuzes can be carried by the rocket, thus giving maximum destruction and excellent prospects of penetrating armour by "shaped" charges.

Weight and bulk of the ammunition are the only seeming disadvantages of the rocket. Considering the dead weight of the gun and its installation, the recoil loads, and the short duration of fire bursts, the shell is actually at a disadvantage. Admittedly, the unrotated rocket is long: the R.4/M was of about 15 calibre-lengths as against about six for an equivalent shell round. The rocket, however, is easier to accommodate, even with belt-conveyor arrangements. On the whole an aircraft designer asked to provide for air-combat rockets instead of gun installations would have his task simplified.

The major disabilities from which the rocket still suffers are high dispersion and low maximum trajectorial speed. Both, however, would be amenable to substantial improvement were the same attention given to rocket-missile development as is bestowed upon guns. Unfortunately the official troglodytes seem to find supersonic rockets unpleasantly new, and appear to regard them as something akin to amusement fireworks rather than as presenting research problems well worth attacking. Rockets are admittedly disappointing at first acquaintance: they present most complex problems, and not in applied ballistics alone. Previous attempts so often failed because there was neither time, means, nor knowledge to separate the problems and to tackle them one after the other as is common in engineering research. The supersonic rocket missile ought to be the object of long-term planning in development. There is little doubt that, with all the knowledge and experience in related fields which has accumulated, such missiles can be made ballistically as effective as shells.

It is deplorable that experimentation with the German R.4/M after the war was carried out in a rather perfunctory manner and with an evidently prejudiced approach. Naturally, the results obtained were disappointing and assessments led to the conclusion that the dispersion was by far too excessive for air combat of the future.

Actually, there is small reason for surprise at the obvious discrepancy between these trials and the undeniable operational evidence. Significantly enough, the experimenters had omitted even to consult the German experts who had been responsible for the R.4/M. The necessity for such consultation was all the more obvious because, according to most reliable information, all technical files concerning the R.4/M and R.A.55 had been burned upon orders. The experimenters thus remained unaware of certain handling properties of the (not fully developed) weapon which would have reduced the dispersion. Moreover, the rockets tested did not correspond to the latest development models. Results of such haphazard *ad hoc* trials as were carried out are, of course, inconclusive, and it is regrettable that the official attitude in this country should have been influenced and stiffened by them.

(To be continued)

AIR-SURVEY TASK FORCE

A BRITISH firm has taken the initial steps in what may well prove to be one of the most interesting and exacting operations ever carried out by a civil air-survey organization.

Towards the end of last year, it was arranged that a squadron of R.A.F. photographic-reconnaissance aircraft should fly to British Guiana to carry out photographic operations in that area; then, following a change in policy, the work was put out to tender and the contract subsequently allocated to the Air Survey Co., Ltd., which is a subsidiary of the Fairey Aviation Co., Ltd.

The operation involved the despatch of two aircraft from the United Kingdom initially to British Guiana, where nearly 20,000 square miles of forest country are to be photographed. Later the two survey units will divide up and tackle other areas including British Honduras, Trinidad, Jamaica, Windward Islands and Barbados.

What might be described as the company's task force consisted of two specially equipped Dakotas which had of necessity to fly the Atlantic and then on a further 4,000 miles to their first base. They carried with them not only the camera installation with the various navigational aids, but also in each aircraft a complete set of processing and printing equipment, together with the ground staff.

The first Dakota left White Waltham on August 17th, and arrived in British Guiana, about 9,000 miles away, on the 22nd. The second left on August 25th and, after taking delivery of special film requirements at the Fairey Aviation airfield in Halifax, Nova Scotia, arrived in British Guiana early in September. In advance of the two aircraft a member of the administrative staff had already arrived to arrange technical and domestic accommodation.

Another branch of the Air Survey Co., Ltd., is based in Calcutta, and here the Government of India has recently renewed the company's contract to supply the Survey of India with its air-mapping photographic requirements for a further period of three years. Incidentally, the London company has, during the past three years, despatched reinforcing aircraft from the United Kingdom to India during the winter months when operations in Europe are more or less at a standstill. Also, in other spheres, aircraft have been sent to Southern Rhodesia, Transjordan and Cyprus, where they have carried out photographic missions as a preliminary to mapping large areas of territory for the local Governments. Dispersed over these and other areas is a fleet of 14 aircraft.

Ground surveyors "in the field" establish control and check points which are later identified on the photographs; the prints are then returned to the laboratories at White Waltham, where the final processes are carried out. The complete maps are also printed at White Waltham, where the company has its own letterpress and litho works.

CLEAN APRONS

NEW methods of washing airport aprons have recently been the subject of trials with, it is reported, results which can be considered highly satisfactory. The fluid used was the synthetic detergent known as Lenka, made by Shell Chemicals, Ltd.

The trials were carried out on the London Airport apron to determine the best and most economical method and dosages. The problem is largely one of removing lubricant deposited on the ground at points where aircraft are replenished. It was found that a hot solution of 8 oz of Lenka to a gallon of water gave good results, 150 gallons of this solution (75 lb of Lenka) successfully cleaning 4,000 sq yds of apron.

Two methods of application were used. In the first the solution was thrown over the area to be cleaned and then promptly swept with a Thornycroft-Lewin revolving-brush outfit, followed after 20 minutes by hosing; in the second instance the solution was poured into the tank of the Thornycroft machine, sprayed and swept at the same time and then left for 2½ hours before hosing. Although a longer operation, this latter method was more thorough.

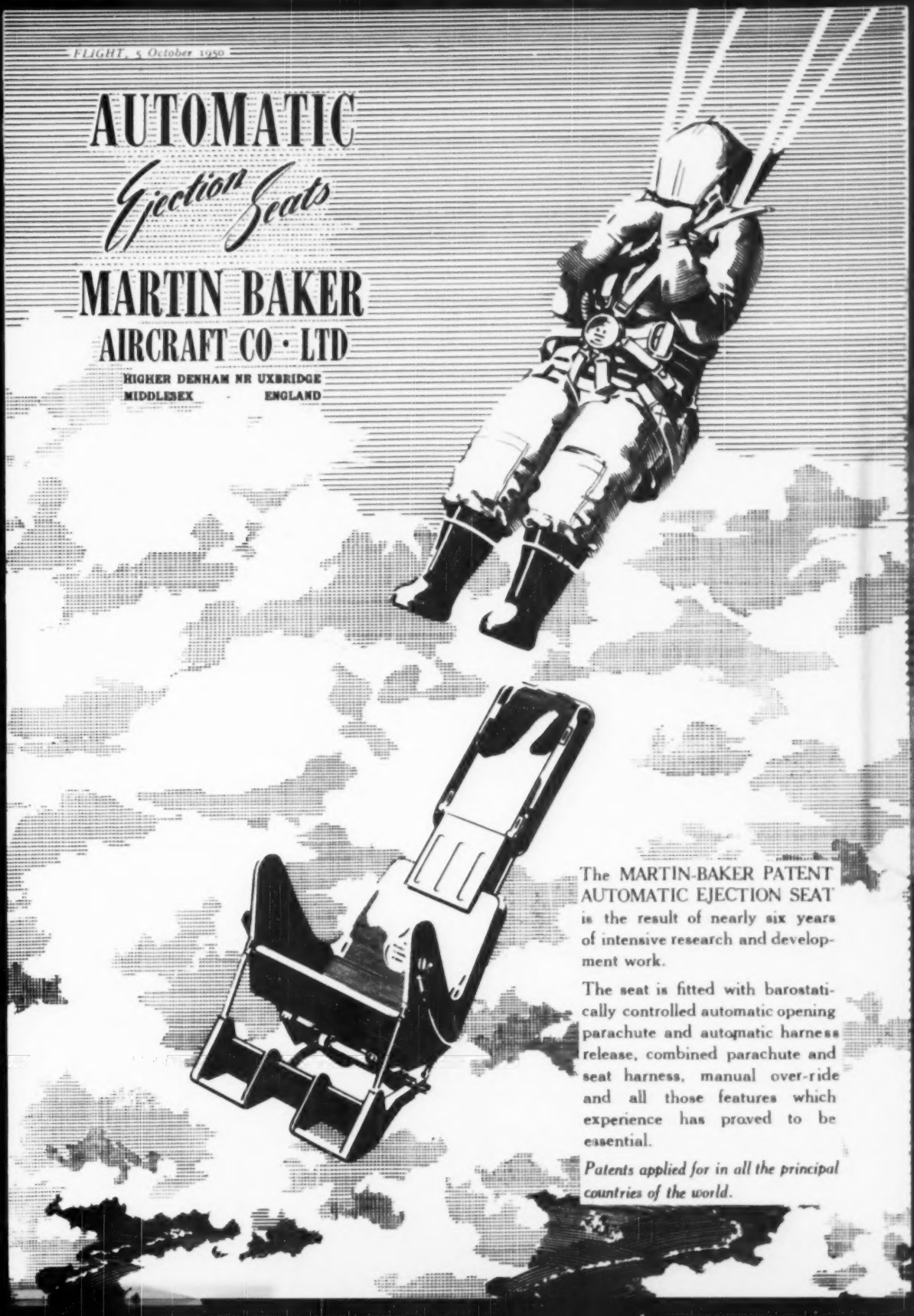
AUTOMATIC

Ejection Seats

MARTIN BAKER

AIRCRAFT CO · LTD

HIGHER DENHAM NR UXBRIDGE
MIDDLESEX · ENGLAND



The MARTIN-BAKER PATENT AUTOMATIC EJECTION SEAT is the result of nearly six years of intensive research and development work.

The seat is fitted with barostatically controlled automatic opening parachute and automatic harness release, combined parachute and seat harness, manual over-ride and all those features which experience has proved to be essential.

Patents applied for in all the principal countries of the world.

FASTER PROMOTION AND—

LONG SERVICE CAREERS

THE NEW TRADE STRUCTURE recently announced for the Royal Air Force ground trades will greatly widen the opportunities that the Service can offer to present and future members. The benefits may be summarised as follows :—

Rank and pay will depend upon experience and individual ability rather than on mere vacancies.

The regrouping of over 100 different Trades into 22 Trade Groups will provide increased opportunities for advancement, and in most of them there will be the opportunity of reaching top rates of pay.

All qualified airmen will have the opportunity to sign on for long service careers up to the age of 55 *with prospects of pensions up to £5 a week.*

A skilled man in any Royal Air Force Trade will have the added opportunity to qualify for promotion as a technician in addition to normal opportunities.

NOW MORE THAN EVER THE R.A.F. IS A TARGET FOR MEN WITH AN AIM IN LIFE

Send coupon now for further details

TO : AIR MINISTRY (F.R.12A.) VICTORY HOUSE, LONDON, W.C.2.

NAME _____

ADDRESS _____

_____ AGE _____

1

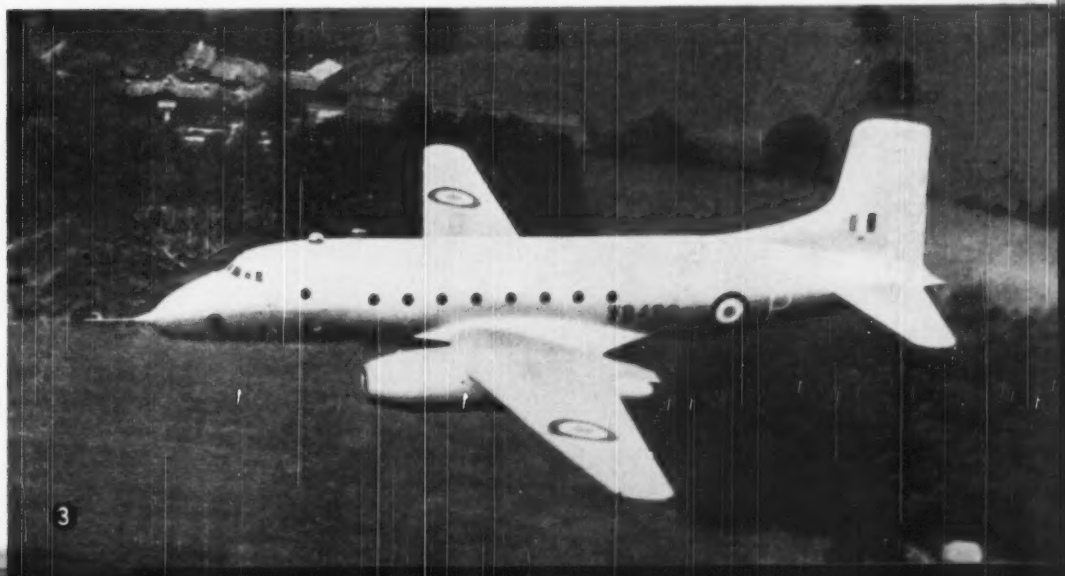
2

THIS YEAR'S MODELS

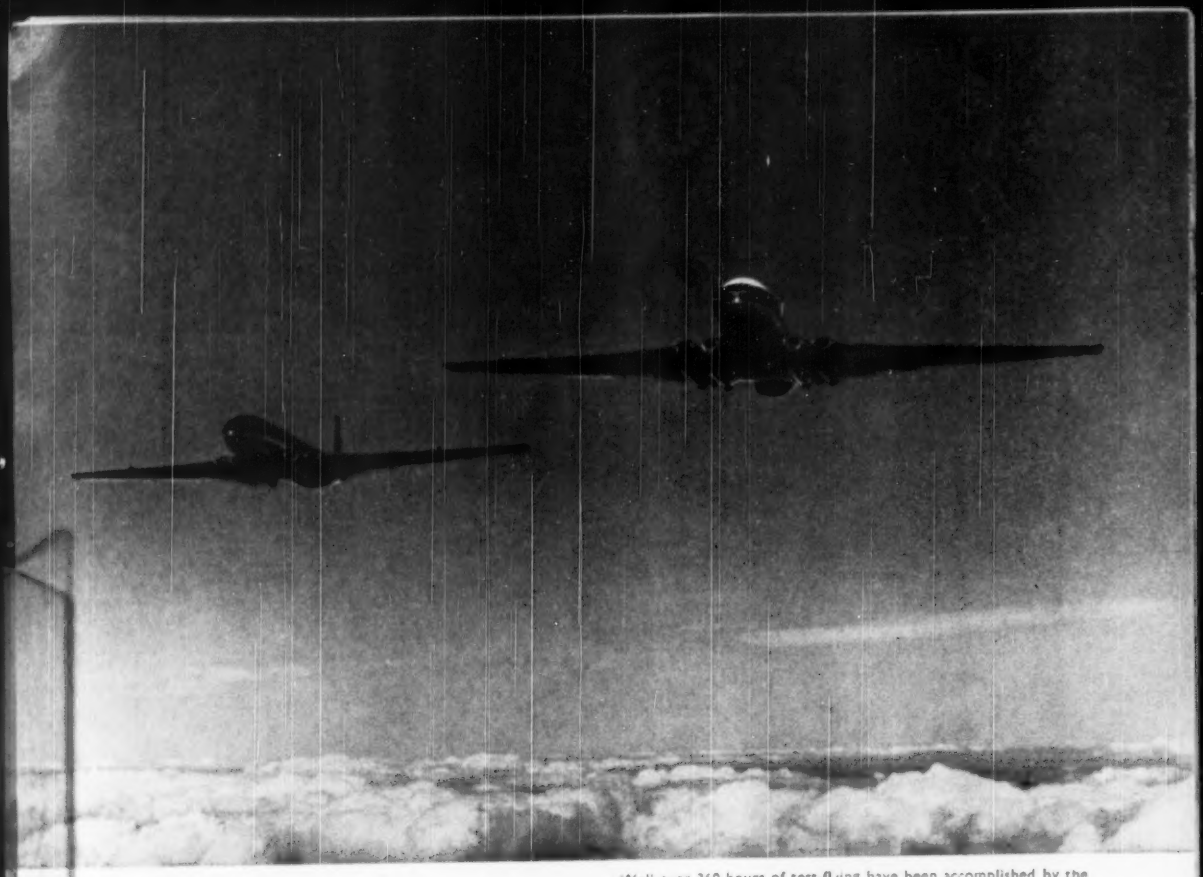
(1) The Supermarine 535 ultra-high-speed jet fighter, powered with a Rolls-Royce Nene turbojet equipped with reheat.

(2) Two Armstrong Siddeley Mamba turboprops are neatly installed in the Short S.B.3 carrier based anti-submarine aircraft.

(3) Capable of over 400 m.p.h., the Avro Ashton high-altitude research aircraft is propelled by four Nenes, in pairs.



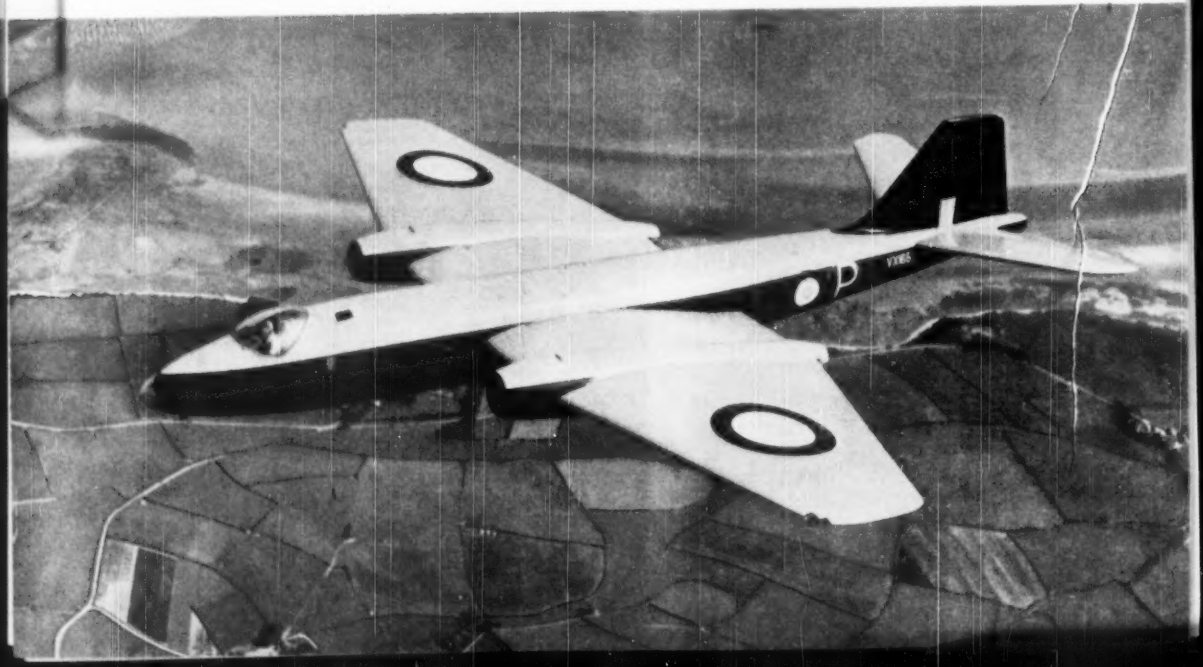
3

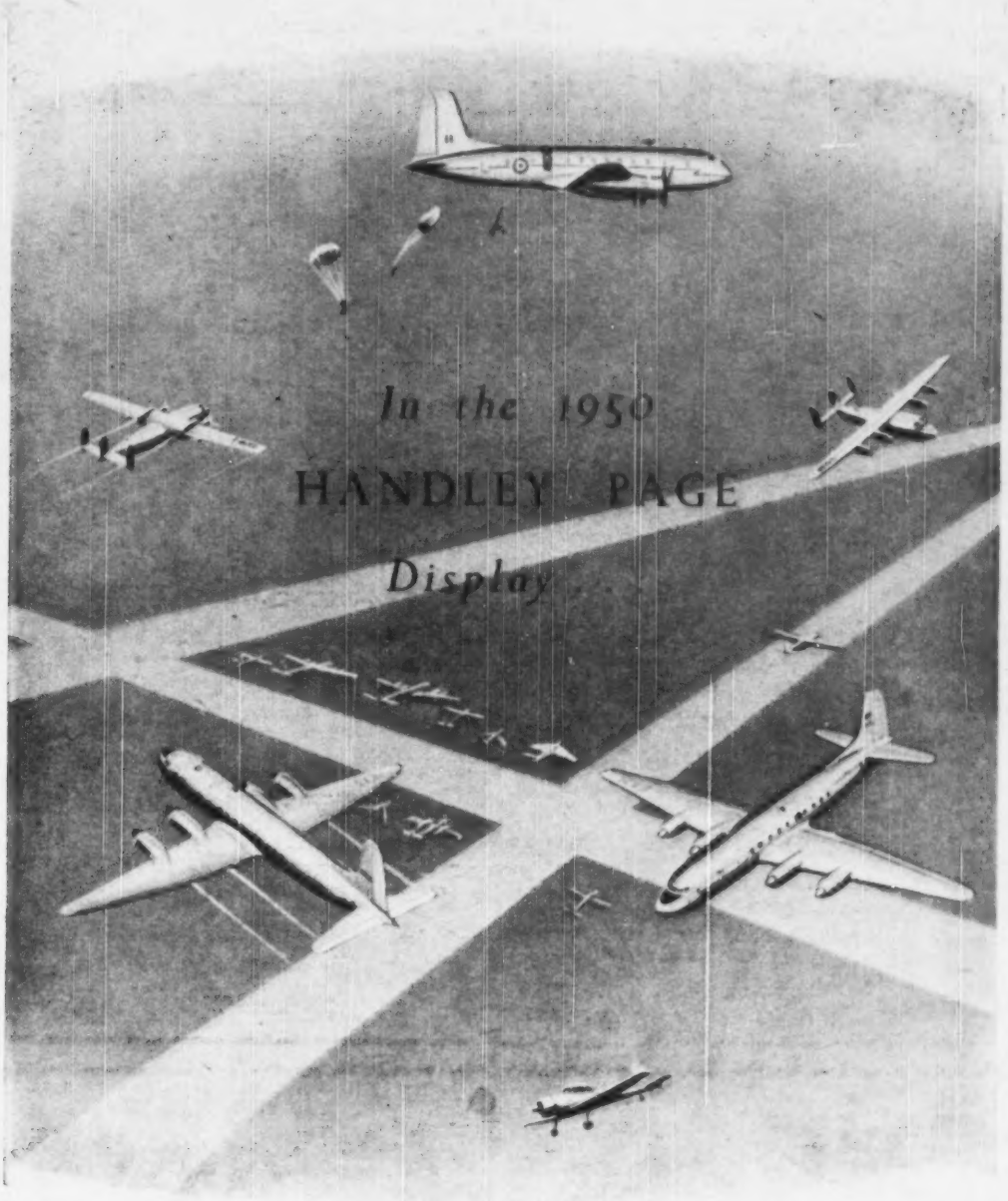


Well over 360 hours of test-flying have been accomplished by the two de Havilland Comets—seen above in "close harmony"—since the first flight of No. 1 on July 27th last year.

PEERLESS

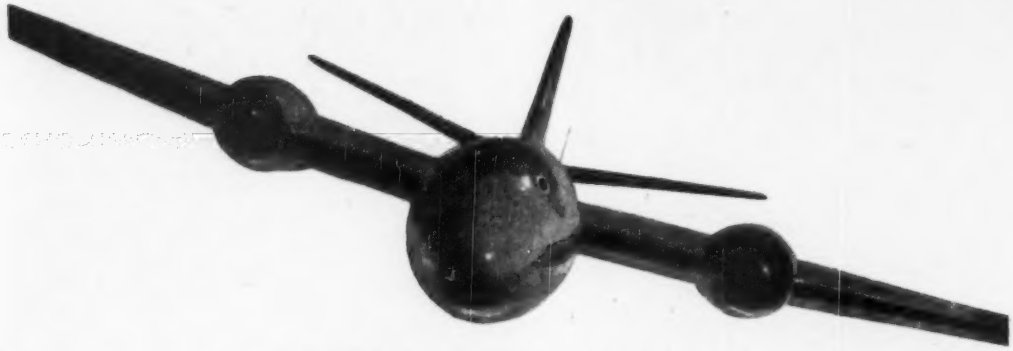
In the coming months the first deliveries of English Electric Canberra B.2 tactical bombers (two Rolls-Royce Avon turbojets) will be made to R.A.F. squadrons. The B.2 prototype is seen.





. . . Transports and Trainers

RADLETT LONDON READING



FROM ANY ANGLE

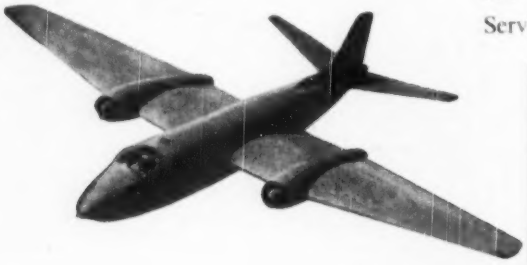
the first thing people notice about the English Electric *Canberra* is the finish — the sheer beauty and purity of its colour. From the outset the designers specified

DOCKERS
Specification DTD 772

because they required a high degree of aerodynamic cleanness and durability, speed of application and ease of maintenance.

Based on Dockers' famous C.R. High Speed Finish, this specification has proved itself in 4 years' intensive experience on record-breaking and production jet aircraft.

Principals are invited to draw on Dockers' experience in this field, and to make full use of our Technical Service.



DOCKERS'
AIRCRAFT FINISHES
FULLY A.I.D. AND A.R.B. APPROVED

Photographs by courtesy of 'The Aeroplane' and The English Electric Co. Ltd.

DOCKER BROTHERS

Makers of Paints, Lacquers and Varnishes for every purpose

LADYWOOD · BIRMINGHAM · 16

CIVIL AVIATION NEWS

ANCIENT AND MODERN : A striking study of man's earliest and latest forms of transport as applied to the pursuit of pleasure. The carriage of racegoers is now a regular source of revenue to charter companies.

"POLICE" POWERS FOR I.A.T.A.

THE Director-General of I.A.T.A., Sir William P. Hildred, has announced the establishment of an Enforcement Section, which will act as a self-policing agency for the world's airline industry. Mr. Rudolph Feick has been appointed Chief Enforcement Officer.

The duties of the section will include the investigations of alleged violations of the resolutions made by I.A.T.A. Traffic Conferences which, with Government approval in the countries concerned, control the rates and fares, conditions of carriage and dealings with agencies throughout the world air-transport system. The Section is intended to help member airlines fully to discharge their obligation to individual Governments to abide by the regulations once the interested nations have approved them.

Upon receiving a complaint, the Director-General can order an investigation by the Enforcement Section and, if the results warrant further action, he can refer the matter to a special commission of three men appointed by him. The commission can impose penalties and fines of up to $25,000 and also expel a member airline from the Association.

The resolution creating this system of inspection, arbitration and penalty has already been approved by a number of Governments.

COMBINED OPERATIONS

WITH all difficulties and last-minute objections now resolved, the merger of American Overseas Airlines and Pan American World Airways has been completed. The transaction involved the transfer of 1,328 personnel and 46 aircraft, and the combined airlines have already begun operating schedules which call for 21 round trips per week between the United States and Great Britain alone. Forty-six aircraft are available for the work of the new combined Atlantic Division which, as previously announced in *Flight*, has been placed under the direction of Brig. Gen. H. R. Harris, formerly a vice-president of A.O.A.

Meanwhile, T.W.A. has inaugurated its new services to London by a flight on which two vice-chairmen of the C.A.B. and leading officials of T.W.A. are accompanying a party of journalists on a tour of the company's European network. The first scheduled service to reach London Airport arrived on September 30th.

THE CORPORATIONS IN MAY

PROVISIONAL figures for the operations of the British airways corporations in May show that, together, they carried 24 per cent more passengers and over 50 per cent more freight than in the corresponding month of last year. Passenger-miles flown increased by more than 25 per cent and freight ton-miles by 16 per cent.

Of the total of nearly 95,000 passengers, B.O.A.C. carried 14,800 and flew more than 43,000,000 passenger-miles; some 4½ million were on South American routes. B.E.A. uplifted over 75,000 passengers and flew nearly 23,000,000 passenger-miles, of which 17,000,000 were on Continental routes.

Charter companies operating scheduled services under associate agreements with B.E.A. flew 698,000 passenger-miles as compared with 246,000 in May, 1949. The total of usable capacity ton-miles flown was increased by 27 per cent, but the overall revenue load factor showed a decrease from 57.6 to 55 per cent.

On the subject of Associate Agreements, the M.C.A. has now announced the issue of a revised directive to the Air Transport Advisory Council which, as before, will consider applications from the charter companies and make recommendations to the Minister. The main change is that maximum period of the agreements may be for as much as five years in suitable cases, as opposed to the previous agreement of two years. As in the earlier arrangements, no subsidies will be granted to Associate companies.

U.S. EMERGENCY PLANS

PLANS for the mobilization of American civil aviation in an emergency have been submitted by an advisory committee to the C.A.A. Civil resources are said to include some 90,000 aircraft—of which 60,000 are now in operation—plus 4,638 airports and half-a-million personnel.

Among other recommendations, the committee urges that stocks of spare parts should be laid in for light aircraft, so that they will still be airworthy when larger machines are diverted for military uses. The report stresses particularly the need for keeping civil aircraft and airports "operating as going concerns," and emphasizes the value of small, widely dispersed community airstrips which could serve as air headquarters for civil defence organizations. Among the duties in which private aircraft might be called on to assist are the transport of medical personnel and vital supplies to bombed areas, evacuation of civilians, decontamination and the provision of emergency conditions.

AMERICAN JET SUBSIDY

LEGISLATION has been passed by both the United States Senate and the House of Representatives authorizing the Government to spend $12,500,000 (about £4,464,000) to assist in the development of turboprop- and jet-powered transports.

The Bill provides for the financing of test flying and modification programmes for prototype aircraft developed by private manufacturers; it will also assist them to conduct operational trials. Three specific types are being aimed at, namely, transports, freighters and small feederliners.

It is understood that the C.A.A. may, if it wishes, apply these funds to the testing of foreign aircraft.

The C.A.A. has also recently submitted for Congressional approval a budget of $53,000,000 to be spent on the implementation of the R.T.C.A.'s "all-weather airways" programme in 1952.

PRODUCTION "DEUX PONTS" FLIES

The first production model of the Bregust 761 Deux Ponts is now flying and the second and third production units will make their first flights in November. It is hoped that the first aircraft will be given a provisional C. of A. in order to allow Nos. 2 and 3 to be used immediately on transport services.

CIVIL AVIATION NEWS

BREVITIES

It has been announced that the Ministries of Communication of Sweden, Norway and Denmark are shortly to meet to discuss plans for the closer co-operation of the three respective national airlines.

* * *

With effect from October 15th, Air India International is to operate an additional weekly service between London and India, making a total of four flights a week in each direction. From that date, also, two of the services which now terminate at Bombay will be extended to Calcutta.

* * *

It is understood that discussions have taken place in Oslo between a member of the Leith Dock Commission and representatives of S.A.S. on the possibility of establishing a flying-boat service between Leith and Norway.

* * *

S.A.S. has increased the frequency of its night services from Copenhagen to Paris from three to five flights weekly. The service is said to be proving very popular, and extra aircraft will be provided should bookings demand it.

* * *

T.W.A. has now taken delivery of 10 of its 12 new Martin 2-0-2As and is introducing them on medium-length and short-haul flights radiating from New York. The 2-0-2As are being operated as "interim" aircraft pending the delivery during 1951 of 40 pressurized Martin 4-0-4s.

* * *

The Brazilian Government has placed an order for 80 Piper Super Cubs, to be used for training purposes under the state-subsidized flying-club scheme. The Piper Cub is available in two versions, powered with either a 108 h.p. or 125 h.p. Lycoming engine. With the more powerful unit the aircraft is certified for a payload of 1,022 lb when used for agricultural spraying or dusting.

* * *

P.A.W.A. has announced an order for a fleet of 18 Douglas DC-6Bs, which are a faster and larger version of the standard DC-6. The order amounts to some $21,000,000 and delivery is scheduled to begin next autumn. It is claimed that the DC-6B, which is powered by Pratt and Whitney R.2800CB-17 engines (each of 2,500 h.p.), will be a high-performance aircraft with particularly low operating costs.

* * *

With the departure on September 24th of a Hermes IV from London Airport, B.O.A.C. inaugurated its new landplane service between London and East Africa. Operating four times a week in each direction, the Hermes will replace the Solent service previously flown between Southampton and Lake Naivasha, near Nairobi. Hermes are already flying on the route between London and West Africa and will shortly be introduced on the Springbok service between London and Johannesburg.

THE AIR-BEEF SAGA: Having completed its first season of transporting carcases from the Glenroy abattoir to Wyndham, A.N.A.'s Bristol Freighter *Mannana* proudly displays her "ops" record.

El Al, the Israeli national airline, has now taken delivery of its first Constellation and will shortly return the DC-4 which was formerly leased to it by the American operators, National Airlines.

* * *

In the second quarter of 1950 aircraft of the Pan American World Airways system flew a total of some 324,485,000 passenger-miles, as compared with 261,714,000 in the corresponding period of 1949.

* * *

With a flight to Leuchars on September 20th, the first prototype D.H. Comet completed 363 flying hours. It later carried out flight trials with D.M.E. equipment, which had been installed within two hours of touching down.

* * *

When A.O.A. advertised recently in Frankfurt that there existed four vacancies for German air hostesses, nearly 500 applications were received. One of them was from a 45-year-old woman who was with the pre-war German airline Lufthansa.

* * *

Following the successful transport by air of live prawns from Hobart to Sydney, Trans-Oceanic Airways, using Sunderlands, is now flying live lobsters on the same route at the rate of 6,000lb on each weekly flight.

* * *

The growth of Trans Australia Airlines is well illustrated by the fact that their annual passenger total has increased from 193,000 in the first year of operation to 543,000 in the fourth. In the financial year ended June 30th the company showed its first profit; and in four years of operation there has not been a single serious accident.

* * *

The Parliamentary Secretary to the M.C.A., Mr. Frank Beswick, M.P., left London Airport on Saturday, September 23rd, for a tour of South America and the West Indies. Taking advantage of the opportunity offered by the Parliamentary recess, he is making the journey to acquaint himself personally with B.O.A.C.'s South American and Caribbean routes and meet the Corporation's staff at various bases.

* * *

The text of a bilateral air agreement between the United Kingdom and Israel was initialled in London on September 22nd, following negotiations which had taken place since August 29th. The agreement provides for regular services to be flown between the two countries and includes landing rights in Cyprus, Lydda, Aden and South Africa.

* * *

Announcing traffic figures for the first six months of this year, Air France states that some 312,000,000 passenger-miles were flown and over 329,000 passengers carried. In July the company broke its previous record for flying hours with a total of 15,645. With the introduction of Bristol 170s on its Far East network the company has also been able to increase the number of services from Saigon to various points in Indo-China. The aircraft are on charter to Air France from the Indo-Chinese company, S.I.T.A.

* * *

One internal operator, National Airlines, seems to be enjoying an unusually large share of the improved traffic recorded by nearly all American companies in the past financial year. National's profit for this period was more than $500,000 and during the year repayment of the company's long-term loan was completed—two years ahead of schedule. Passenger-mileage rose by 48 per cent, although capacity was increased by only 29 per cent. The company is now operating "air coach" services on the east coast of the United States at fares one-third less than normal airline rates.

* * *

The Australian Airline Pilots' Association has requested ten major operators to increase the salaries of their 750 pilots by 33 per cent. Other claims include three months' notice of dismissal, 28 days' recreation leave each year, and superannuation as a legal entitlement. The Association alleges that Australian pilots receive the lowest salaries in the world, and give comparative annual rates of pay for "Grade I" pilots in Australia, Great Britain and the United States as being £1,350, £2,062 and £6,207 respectively. There is also said to be a growing shortage of pilots in the country and for the first time T.A.A. is advertising vacancies for aircrew.

SMITHS WAYMOUTH GAUGE

Smiths-Waymouth fuel contents gauge gives continuous, accurate indication of fuel tank contents irrespective of attitude, movement, temperature or other flying conditions. The contents of an individual tank or total contents can be read at the turn of a switch. The system employed uses neither moving parts nor high-voltage current in the tank. The gauge is reliable, safe, light in weight and simple to instal and maintain.

Fitted to:

CIVIL AIRCRAFT

De Havilland	Comet
Airspeed	Ambassador
Percival	Prince and Range Prince
Handley Page	Hermes IV Hermes V

MILITARY AIRCRAFT

English Electric	Canberra
Vickers Supermarine	Attacker
Hawker	P.1052 Sea Hawk

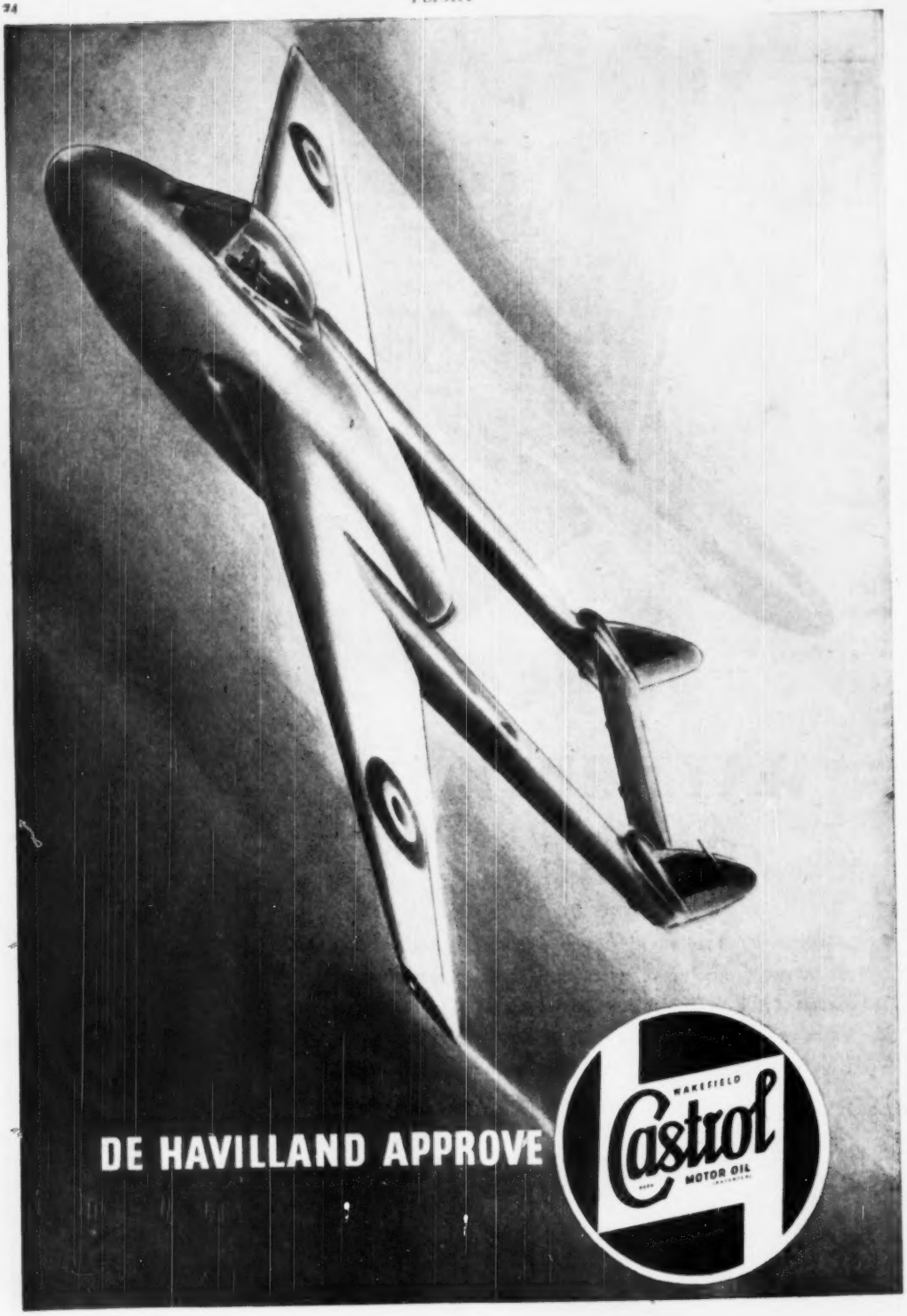
And many other prototype civil and military aircraft.

SMITHS AIRCRAFT INSTRUMENTS LIMITED

159

SMITHS

SMITHS AIRCRAFT INSTRUMENTS LIMITED Cricklewood Works, London, NW2. The Aviation Division of S. Smith and Sons (England) Limited


DE HAVILLAND APPROVE
WAKEFIELD
Castrol
MOTOR OIL

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

"Hadrian's" History

IN a letter published in *Flight* of September 14th, Mr. John Stroud asks for information about the fate of G-AAUE, *Hadrian*.

I saw this aircraft at Ternhill on February 6th, 1941, with R.A.F. markings and with an R.A.F. crew. She was engaged in trooping, i.e., flying aircraftmen from one R.A.F. station to another.

I particularly remember the date, because I had flown *Hadrian* on many trips from Heliopolis to Karachi and Kisumu on the routes operated by Imperial Airways, and I made a note in my logbook. This being so, *Hadrian* must have been the last survivor of the H.P.42s. I would be interested to learn what happened to her in the end.

Bourne End, Bucks G. S. BROWN.

[With airline-flying experience dating from 1929, Capt. Brown joined Imperial Airways in 1935 and is now Inspector of Accidents to B.O.A.C.—ED.]

Soviet Aircraft

I WAS interested to see the illustrations of new Russian aircraft in your issue of January 26th. My own information is that at least one new single-jet fighter of the swept-back type depicted appeared towards the end of the 1948 Moscow Air Display. It was painted white all over and bore no red star insignia. The swept-back "research" type also illustrated by you was not seen in the 1948 Display, as you report. My informant is an air-minded friend who has seen the film of the 1948 Display four times in Siberia. Many types of military and private aircraft, he tells me, appeared in the Display of that year. He lists them roughly as follows: at least one new "Yak-like" fighter; about 30 Mig-15; about 50 Mig-9; about 100 Yak-15; about 50 Yak-9; about 50 Tu-2; at least five Pe-2; 100-200 "Tu-29"; about 10 Il-18; nearly 200 Il-12. Moreover, at least one unidentified straight-wing, twin-jet bomber and a twin-boom, twin-engined reconnaissance aircraft were also noted. There were several hundred light single-engined two-seaters, and large quantities of one- and two-seater gliders, in addition to a helicopter stated to resemble the Cierva Air Horse. The film was Agfa-coloured and had been making a long-run hit in Siberia in the middle of last summer.

In addition, my informant noticed the existence of many unknown Soviet former Naval dive bombers resembling the Japanese "Jill," which was operating in 1943-45 in the Pacific. These were mostly active in Nahotoka, ten miles east of Vladivostok and occasionally served as target tugs. Other types seen in quantity were Mig-15s, Yak-15s, Yak-9s, La-9s, La-7s, Tu-2s and Il-2s. He also observed some improved Tu-2 light bombers with square-tipped wings and elongated vertical tail surfaces; these likewise often served for target-towing.

Tokyo, Japan A JAPANESE AUTHORITY.

Air Scouts

MANY of your readers will have heard that the Air Ministry has agreed to recognize Air Scouting and to give considerable help to Air Scout Troops which reach a sufficiently high standard.

It is a decision which cannot fail to add to the attraction of Air Scouting; but while it offers a great opportunity, it also brings a problem. More Air Scout leaders and more part-time instructors in technical subjects are needed if this youngest branch of the Scout Movement is to expand as fully as it can.

There must be many former Scouts with air experience among your readers who could help and many who, while not wishing to wear Scout uniform and undertake active Scouting would yet be prepared to sacrifice an occasional evening to passing their knowledge and experience to air-minded boys.

If there are any who wish to help but do not know of any Air Scout Troops in their vicinity, I will be glad to give them full details on application to our H.Q. at 25, Buckingham Palace Road, London, S.W.1. Their help is urgently needed.

A. W. HURLL, Chief Executive Commissioner.

London, S.W.1. The Boy Scouts Association.

Veteran Banner-tug

YOUR article on banner towing, in the latest copy (August 17th) of *Flight* to reach me, reminds me, as an ex-engineer in the Fleet Air Arm, that there is a Swordfish in this country that still flies from time to time. It is hangared at Baragwanath, near Johannesburg, and is occasionally used for advertising purposes. Perhaps there are still others of these veterans which are yet flying. R. J. FARQUHARSON.

Benoni, Transvaal.

IN BRIEF

Mr. Sverre Klouman, teacher of English at the Royal Norwegian Air Force College, Myntgt 2, Oslo, is preparing a booklet on the development of the English aeronautical vocabulary, and he would be grateful for any assistance as to the origins of typical words and phrases. "Very often," he writes, "it is possible to trace a single word or expression back to a certain person, coterie or circumstance."

BRAKING BY HARPOON

THE U.S.A.F. is reported to be experimenting with a rocket-propelled "anchor" intended to shorten the landing run of small aircraft and gliders. Just before touch-down, the pilot fires rocket propellant contained in a steel tube (28in long, and of 1¼in diameter) mounted in the tail of the aircraft. The tube itself is fired 18in into the ground at an angle of 40 deg, and deceleration energy is absorbed by a hydraulic winch fitted in the aircraft and connected to the tube by 200ft of steel ribbon.

THE MEDICAL ASPECT

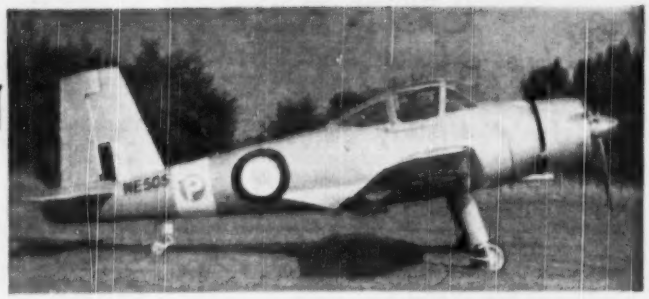
SINCE it is generally recognized that an unstable temperament suffers adversely from reading about bodily ills it is open to question whether it is altogether a good thing for the laymen to peruse an otherwise admirable work on the various aches, pains and discomforts which modern aviation can, in some circumstances, inflict on the individual. Certainly the ordinary airline traveller or occasional flier must avoid such literature if he wishes to preserve his peace of mind. But for the professional aeronaut, or those whose responsibility it is to ensure the comfort and safety of people who fly, an appreciation of the basic principles of what is known as "aviation medicine" is unquestionably most valuable.

Air Marshal Sir Harold Whittingham, K.C.B., K.B.E., LL.D., F.R.C.P., who is Director of Medical Services to B.O.A.C., has written a contribution on the subject for the forthcoming *British Encyclopædia of Medical Practice*, and for private circulation he has had it reprinted in the form of a well-illustrated 66-page art-paper booklet. As the encyclopædia is primarily intended for the general practitioner profound aeronautical technicalities are avoided; at the same time, most of the medical terminology is readily understandable by the average intelligent reader, and, even studied academically, the contents of Sir Harold's thesis are of very considerable interest. The main subject-headings are Medical Fitness for Flying, Maintenance of Physiological Efficiency, Emergencies, Medical Fitness for Air Travel, and Airline Hygiene.

THE VINE GROWS WINGS

BACCHUS and Mercury conspired to make the evening of the 27th a memorable one at the Wine Trade Club in the City. The occasion was the presentation, by the Brandy Shippers' Association, of an inscribed cigarette box to Mr. T. W. Shipside, winning British entrant in the Cognac Air Rally this year. Mr. Shipside, who flew with his wife, son and daughter in the family Gemini, was placed 11th in a field of 44, including 21 British entrants. M. Chevaux, president of the Aero Club of Cognac, flew over by B.E.A. to be present. He hopes for an even more successful rally next year.

SERVICE AVIATION



MODIFIED: The latest prototype of the sturdy new H.P.R.2 basic trainer embodies a number of changes in the original design, notably the installation of an Alvis Leonides engine (a Cheetah was formerly fitted), and alterations in the configurations of both fin and cockpit-canopy.

Royal Visit

IT is announced that H.R.H. Princess Elizabeth will visit Fighter Command Headquarters at R.A.F. Bentley Priory, Stanmore, Middlesex, on Thursday, November 9th.

S. of S. Overseas

MR. ARTHUR HENDERSON, the Secretary of State for Air, left London on September 20th for a tour of R.A.F. units in the Middle East, which also included short visits to Jordan, Israel and Greece. The Under Secretary, Mr. Aidan Crawley, left seven days later for a visit to R.A.F. units in the Far East, including those taking part in the Korean war. Another overseas inspection—of the Middle East—is being made by the Air Member for Personnel, Air Chief Marshal Sir Leslie N. Hollinghurst.

African Survey

SINCE last January, the Lancasters of No. 82 Squadron have photographed 119,000 square miles of African territory in connection with colonial development schemes. For the last six months, the Squadron has been operating over East Africa, Northern Rhodesia, and South Africa to assist preparation for new railway and hydro-electric projects, but is now returning to its original base at Takoradi, on the Gold Coast. The unit began its work in Africa four years ago.

Autumn Exercise

ZERO hour for Exercise *Emperor*, the largest R.A.F. and A.A. Command air exercise to be held since the war, is 1200 hr on Saturday next, October 7th. The exercise will be under the direction of Air Marshal Sir Basil Embry, A.O.C.-in-C., Fighter Command. Air Marshal Sir Hugh P. Lloyd, A.O.C.-in-C., Bomber Command, and Gen. Leon W. Johnson, Commander of the U.S.A.F. Third Air Division, will control the attacking forces.

Air-force participation will be cosmopolitan. The R.A.F. will provide aircraft from Fighter, Bomber and Flying Training Command, B.A.F.O. and the Middle East Air Force; American Superfortresses and Thunderjets will be engaged, as will aircraft of the R.N. and R.N.V.R. The air forces of France, Belgium, the Netherlands, Norway and Denmark will take part in the exercise, either in the air or on the ground.

All 20 of the Auxiliary fighter squadrons will operate during the week-end phases of the exercise; several will be stationed away from their home bases. The three Scottish Spitfire squadrons—No. 602 (City of Glasgow), 603 (City of Edinburgh) and 612 (County of Aberdeen)—and Nos. 616 (South Yorkshire) and 500 (County of Kent), both flying Meteor 3s, will operate from airfields in Southern England. No. 608 (North Riding) squadron (Vampires) will be stationed in the West of England, No. 614 (County of Glamorgan), also using Vampires, in East Anglia, No. 607 (County of Durham) in Yorkshire, and No. 502 (Ulster) in Lancashire. The two last-named squadrons are equipped with Spitfires.

One complete fighter sector will be under Auxiliary control and three radar stations in other sectors will be manned by F.C.U. personnel. The Royal Observer Corps will also play an important part in the defence organization and Auxiliary Bofors gunners will protect several airfields against low-flying intruders.

The exercise will be divided into three phases: Noon Saturday, October 7th, to dawn Monday, 9th; dawn Tuesday, 10th, until dawn Friday, 13th; and noon Saturday, 14th, to dusk Sunday, 15th.

"The Hawk" to Reappear

IT has now been found practicable to resume publication of *The Hawk*, the journal produced annually by the R.A.F. Staff College in pre-war days, and the next issue is to appear in December. First produced in 1928, this journal has as one of its main objects the maintenance of a link between the 3,000-odd graduates of the College and present students and staff. Any graduates who have not received a personal letter about the resumed publication are asked to communicate with The Hon. Secretary, *The Hawk*, R.A.F. Staff College, Bracknell, Berks. The forthcoming issue (priced at 5s, post free) will have a foreword by Lord Trenchard and articles by several senior officers who were associated with the College in its early days.

Jolliffe Trophy Awarded

THE Jolliffe silver challenge trophy, awarded annually to the R.A.F. station judged to have the best dining halls, has been won this year by Oakington, Cambs, with 98 per cent marks. Leeming, Yorks, was second with 97.5 per cent, and Turnhouse, Edinburgh, third, with 95.5 per cent.

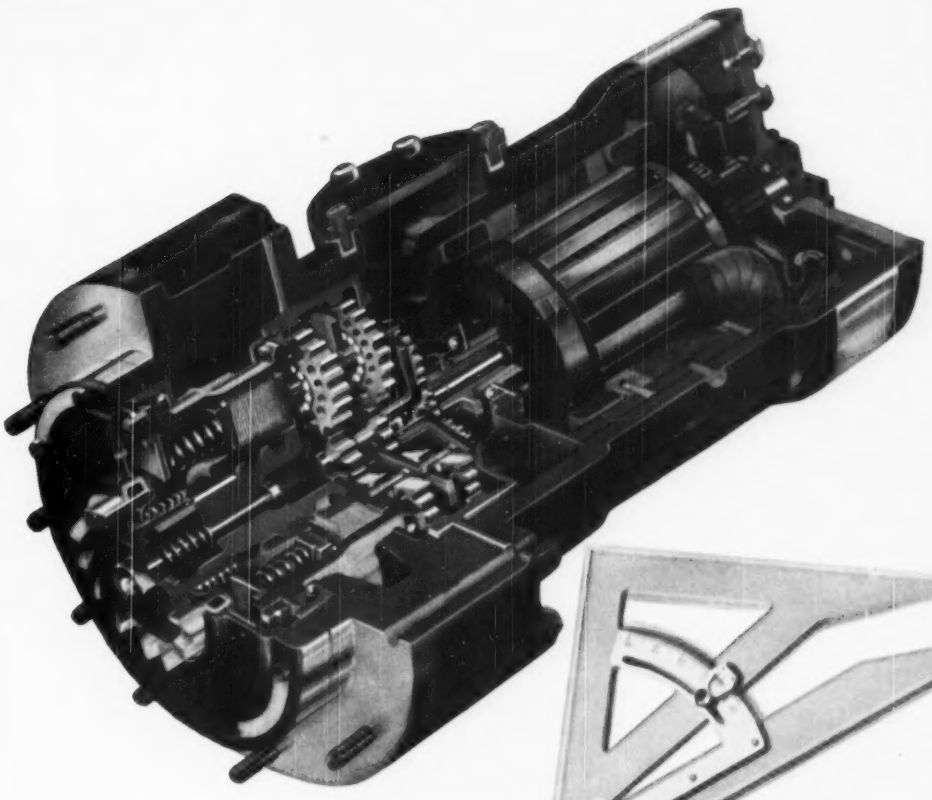
Reunions

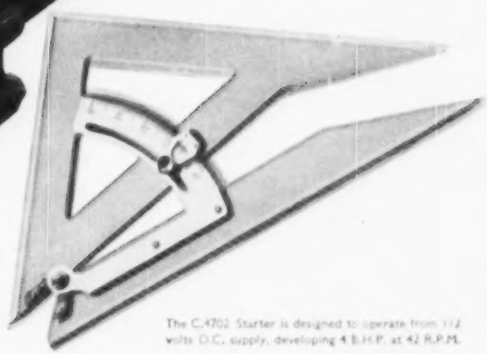
NO. 150 SQUADRON reunion at 6.30 p.m., on Saturday, November 4th, at The Round House, Wardour Street, London, W.1. Tickets (buffet supper) 5s.

• • •

No. 287 Squadron reunion at 6 p.m. on Saturday, October 21st, at the Shakespeare Hotel, Trafalgar Square, London. Details from F/L. R. F. Grose, New Bridge Street, Ludgate Circus, London, E.C.4.

WILTSHIRE VICTORY: At the annual R.A.F. Horticultural Show, held in London recently, Lady Slessor, wife of the C.A.S., presented the R.A.F. Farms and Gardens Trophy to G.C. F. R. Drew, commander of the winning station—Hullavington.





The C.4702 Starter is designed to operate from 112 volts D.C. supply, developing 4 B.H.P. at 42 R.P.M.

EXPERIENCE ✳

The 112 volt D.C. system has outstanding advantages over the 24 volt system. Our many years of experience in designing electrical systems for the world's leading aircraft places us in an unrivalled position to offer the most extensive range of 112 volt D.C. equipment—starters, motors, generators and the resultant lightweight wiring system.

✳

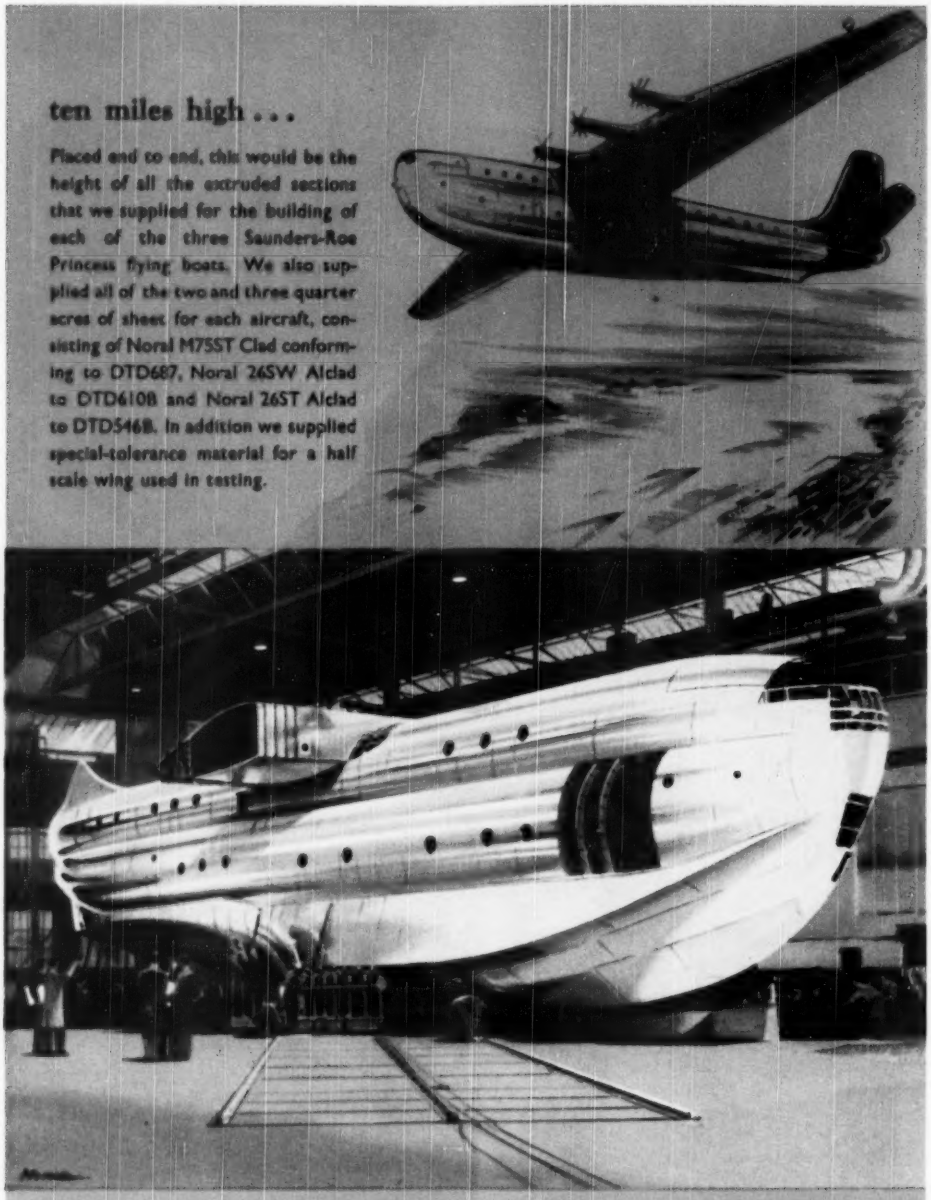
Advice based on our accumulated experience in this field is freely available. We shall be pleased to send you an enquiry form upon which to outline your requirements.

ROTAX

ROTAX LIMITED, WILLESDEN JUNCTION, LONDON N.W.10, ENGLAND
ROTAX AUSTRALIA PTY., 81 BOUVERIE STREET, MELBOURNE N.3., VICTORIA
ROTAX CANADA LIMITED, MONTREAL AIRPORT, DORVAL, P.Q.

ten miles high . . .

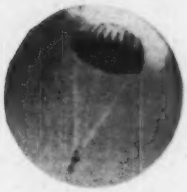
Placed end to end, this would be the height of all the extruded sections that we supplied for the building of each of the three Saunders-Roe Princess flying boats. We also supplied all of the two and three quarter acres of sheet for each aircraft, consisting of Noral M75ST Clad conforming to DTD687, Noral 26SW Alclad to DTD610B and Noral 26ST Alclad to DTD546B. In addition we supplied special-tolerance material for a half scale wing used in testing.



Northern Aluminium COMPANY LIMITED

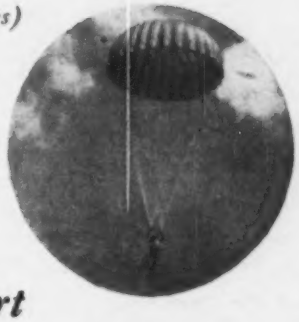
MAKERS OF NORAL SHEET, STRIP, PLATE, SECTIONS, TUBING, WIRE, FORGINGS, CASTINGS, PASTE FOR PAINT

TECHNICAL DEVELOPMENT DIVISION: BANBURY, OXON. SALES OFFICES: LONDON, BIRMINGHAM, MANCHESTER, BRISTOL, NEWCASTLE-ON-TYNE, LEEDS



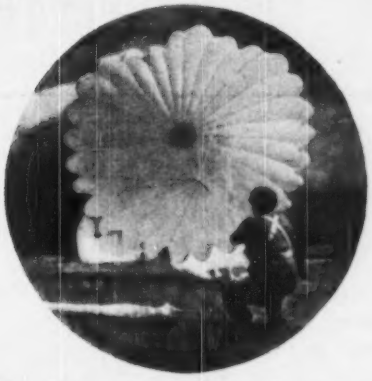
All over the world

men (and supplies)



needing some visible

means of support



are suited down to the ground with

IRVIN

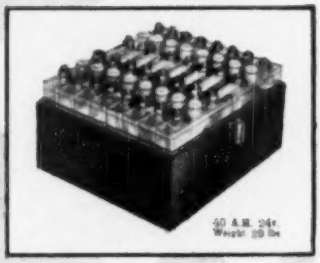
THE IRVING AIR CHUTE OF GREAT BRITAIN LIMITED · LETCHWORTH · HERTS · ENGLAND

Telephone : Letchworth 888 Telegraphic Address : Irvin, Letchworth.

★ Since the War it has been the privilege of the manufacturers of Irvin Airchutes to supply parachutes of all types and for every purpose to Governments, Naval, Military and Air Forces, and Air Lines in the countries listed below. There could be no more striking demonstration of the world-wide confidence accorded to and instilled by the name IRVIN

ARGENTINA	CANADA	GREAT BRITAIN	NETHERLANDS	PORTUGAL
AUSTRALIA	DENMARK	HOLLAND	EAST INDIES	SPAIN
BELGIUM	ECUADOR	INDIA	NORWAY	SWEDEN
BRAZIL	EGYPT	IRAQ	PERU	U.S.A.
	FRANCE	MEXICO	POLAND	

THE PAY LOAD IS UP...
...thanks to Venner Lightweight Accumulators



These revolutionary new Alkaline storage batteries are ideally suited for saving both WEIGHT and SPACE in aircraft—the vital factors affecting higher pay loads.

Toughness, long life and efficient performance are but highlights among their many outstanding features.

The services of our technical staff are at your disposal in investigating the operational advantages of these accumulators.

Approximately ***one third the weight*** and ***half the size*** of other accumulators of similar capacity. Shockproof — completely unspillable — fully insulated — operates in any position — unharmed by accidental overloads. Can be left charged, semi-charged or discharged without harm.

FOR DETAILS OF ALL TYPES WRITE FOR LEAFLET V.A. 006/F

Not at present available for engine starting.

VENNER ACCUMULATORS LTD *Telephone :* MALden 2442 (9 *lines*)

KINGSTON BY-PASS, NEW MALDEN, SURREY.

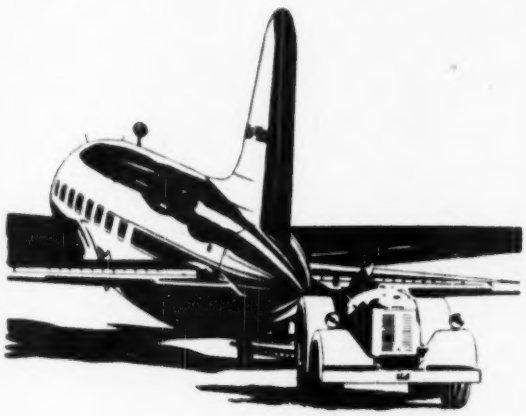
Ground Staffs know

that an aircraft spends more time on the ground than in the air.

Efficient air travel depends on smart ground organization, quick turn-around, speedy refuelling, freight loading—in short, economical handling at ground level.

That's the job of the David Brown TASKMASTER, designed for just this work, with its powerful 39 b.h.p. engine, rugged construction and 6-point towing hitch. With a fast top speed of 22 m.p.h. the TASKMASTER has a first gear drawbar pull of 3,500 lb. and complies with the Road Traffic Act.

Write for our leaflet DBT. 161 or better still, let us arrange a demonstration on your own airfield.

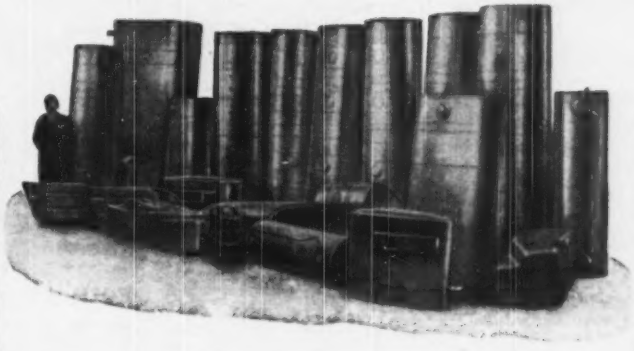


DAVID BROWN
Industrial Tractors

DAVID BROWN TRACTORS MELTHAM HUDDERSFIELD

EVERYTHING IN SHEET METAL WORK

AND LIGHT ENGINEERING



AIRCRAFT
AUTOMOBILE
COACH AND BUS BODIES
Municipal and other ALL-METAL Vehicle Bodies

Refrigeration
COLD STORAGE
HEATING
DRYING
AIR Conditioning
MINING

TELEGRAMS: BROMELPAR, SOUTHTOT. LONDON

E. G. Brown & Co. Ltd

TELEPHONES: TOTTENHAM 2257, 2258 & 2259

161 West Rd., TOTTENHAM LONDON N.17

Portrait of a Minor Menace

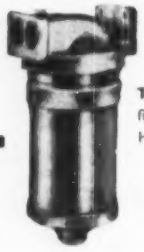
Only a perfectionist would use Brooks components as catapult ammunition—so beware! Smith minor is marauding. No mercy given—no quarter asked. Your pleas go unheeded—your orders disregarded. If you like your components delivered in a surer, safer way, why not contact T. J. BROOKS—whose service is almost embarrassing.

T. J. BROOKS (AUTOS) LTD.
LEICESTER
Telephone: 60987
The most progressive name in component manufacture

WHAT HAPPENS TO YOUR FILTERS AT 100 BELOW?

Recent tests confirm that temperatures of -60°C. are constantly experienced in high altitude flying. Even temperatures as low as -100°C. have been encountered over the Mediterranean. These tests show, too, that certain types of filter element ice up with a sludge of very fine, needle-like ice particles which completely choke the filter service. Here is further striking proof that evidence of the particle sizes dealt with by filters are not alone the whole story. What is needed is absolute protection under *all* conditions, *and in 30 years of hard practical experience and constant research, nothing has been found to improve upon the VOKES basic principles in this respect.*

Two basic principles contribute to the efficiency of VOKES filters — a specially selected felt supported by metal gauze . . . and a patented radial fin construction which provides the *maximum filtering area.* Due to this design, the velocity of any fluid passing through these filters is therefore only one six-hundredth of the normal through the system. Back pressure is thus reduced to a minimum and initial efficiency is entirely unaffected by subsequent cleaning.



THE E.109 FUEL FILTER fitted as standard to the De Havilland "Ghost" jet engine.

For maximum efficiency under all conditions — Specify

VOKES

FILTERS

Pioneers of scientific filtration

VOKES LTD. Head Office: Guildford, Surrey.
London Office: 40, Broadway, Westminster, S.W.1.

Represented throughout the World.

VOKES (CANADA) LTD., TORONTO VOKES AUSTRALIA PTY. LTD., SYDNEY

AIRPORT BANKING

All travellers by air are invited to call at the Airport branches of the Midland Bank and its affiliation, the Clydesdale and North of Scotland Bank. These offices are conveniently situated in the Passengers' Arrival Halls at the airports and provide a complete banking service, including facilities for foreign exchange and other banking requirements of travellers.

MIDLAND BANK LIMITED

NORTHOLT AIRPORT
Middlesex
LONDON AIRPORT
Heathrow
CROYDON AIRPORT
Surrey
RINGWAY AIRPORT
Manchester
B.O.A.C. MARINE AIRPORT
Southampton

CLYDESDALE AND NORTH OF SCOTLAND BANK LIMITED

PRESTWICK AIRPORT
Ayrshire

Aircraft
Aircraft repairs
Aircraft components

THEY WHO LOOK AHEAD

WE WHO HAVE KEPT FAITH FOR OVER FIFTY YEARS LOOK FORWARD TO THE FUTURE WITH EVER INCREASING CONFIDENCE

Helliwells Ltd

HEAD OFFICE THE AIRPORT WALSALL STAFFORDSHIRE
Telephone: Walsall 4553 (6 lines) Grams: Helliwell Walsall
Dept. S.

APPROACH MAPS BY COURTESY OF MESSRS. INTERNATIONAL AERADIO LTD.

WORLD-WIDE RELIABILITY
by

Teddington CONTROLS

KALLANG AIRPORT (SINGAPORE)
Lat.: 01° 18' 20" N. Long.: 103° 52' 30" E. Elev.: 10ft.
1,830 × 60 yds. Distance from Singapore 2 miles. 1 runway

Electro-Pneumatic, Hydraulic and Fuel Valves, Pneumatic Jacks, Pressure Switches and Control Valves, Thermostatic Inching Controls, Cabin Heater and Temperature Control Equipment, Seamless Metal Bellows and Packless Glands, Time Switches.

TEDDINGTON CONTROLS LTD
CEFN COED. MERTHYR TYDFIL. SOUTH WALES

FLIGHT

CLASSIFIED ADVERTISEMENTS

Prepaid Advertisement Rates: 3/- per line, minimum 6/-, average line contains 6-7 words. Special rates for Auctions, Contracts, Patents, Legal and Official Notices, Public Announcements, Tenders, 4/- per line, minimum 8/- per paragraph. Box Number facilities available for the convenience of private advertisers, add 2 words plus 1/- to defray the cost of postage and forwarding replies. Press day, FIRST POST THURSDAY, or on 4th day earlier at Branch Offices. No responsibility accepted for errors. Remittances payable to: Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

AIRCRAFT EQUIPMENT

Large stocks of new and unused clothing, life saving, oxygen and electrical equipment for aircraft.

Large supplies already delivered to many foreign governments; certificates available if required.

We welcome home and overseas enquiries, given either description or R.A.F. vocabulary section and reference numbers.

D. LEWIS LTD.

Leather Clothing Manufacturers for Home or Export

(Dept. F.)

124 GT. PORTLAND ST. LONDON, W.1

Trade Enquiries Invited

Tel.: Museum 4314. Tele: Acclabit, Wesdo, London

DELIVERY EX-STOCK FULLY RELEASED EXPORT WELCOMED

DAKOTA — GENERATORS AND STARTERS
DAKOTA — PANEL INSTRUMENTS
DAKOTA — GROUND TEST EQUIPMENT
DAKOTA — ANCILLARY EQUIPMENT
DAKOTA — ELECTRICAL EQUIPMENT
DAKOTA — TYRES, SPARK PLUGS, MAGNETOS, CARBURETTERS, P. & W. ENGINES

STARAVIA BLACKBUSHE AIRPORT, CAMBERLEY, SURREY

TELEPHONE: CAMBERLEY 1600 EXT 70

The...
British Air Line Pilots' Association
SUITE 6, 9-10 MARBLE ARCH, W.1
Tel.: AMBassador 1357

Membership open to all Commercial and Service pilots. For full details as to objects and particulars of Membership please write to secretary.

AIRCRAFT FOR SALE

FIELDS

RAPIDE aircraft for sale at the most competitive prices in the trade, a range of very fine machines are offered complete with 12 months' C. of A.; send for details to Field Aircraft Services, Ltd., Croydon Airport, Croydon. Croydon 7777. Cables Fieldair, Croydon. [0258

R. K. DUNDAS, Ltd.

AVIATION Division, 29, Bury St., London, S.W.1

FOR all

AIRCRAFT and spares.

AIRCRAFT and aerodrome equipment.

29, Bury St., London, S.W.1

WHITEHALL 2648. [0559

CENTRAL AERONAUTICAL BUREAU, Ltd.,

HAVE for disposal the following aircraft:—

£550 Aerovan, under 300 hours since new, long-range tanks, in perfect condition; fly away, £950.

£350 Anson Mark I 7-seater, in sound condition, fully modified and furnished.

£175 Hawk Major, low hours, sound throughout, dual control, full instruments.

£175 Fairchild Argus, first-class condition, very little used, fully furnished.

£85 £525 Tiger Moths, three available with or without C. of A.

£165 Magisters, 5 available in civilian colours and reconditioned throughout.

CENTRAL AERONAUTICAL BUREAU, Ltd., Croydon Airport, Croydon. 5582 & 7744 (ext. 111). Cables, Centralair, Croydon. [5620

F. G. MILES, Ltd., Redhill Aerodrome, Surrey. Nutfield Ridge 2200.

MILES Gemini Mk. 1A airframe 430 hours, engines 300 and 240 hours, full B.F. instr. vac. pump driven mixture controls, F.P. 400 props., Murphy 2-channel V.H.F., exceptional finish inside and out, formerly the personal machine of Mr. F. G. Miles, C. of A. expiry April, 1951, overhauled and reconditioned by ourselves, £1,450.

MILES Gemini Mk. 1A, airframe and engines under 100 hours total, dual flying controls, vac. pump driven B.F. instr., nav. lights, 350-watt generator, whip and H.F. aerial; C. of A. expiry June, 1951, highly recommended; £1,800.

MILES Falcon Six, to be sold ready to race for £550; an exceptionally fine example of this famous breed. Details on request.

MILES Gemini Mk. 1A.—We are at present rebuilding one of these aircraft and installing zero-hour engine and F.P.400 propellers, full I.C.A.O. B.F. instr., vac. pump driven, nav. lights, landing lamp, mixture controls, air temp. gauges, screening for radio, finish to customer's requirements, better than new, 12 months' C. of A. and our guarantee; £1,995.

F. G. MILES, Ltd., Redhill Aerodrome, Surrey. Nutfield Ridge 2200. [0590

FOR sale, 2 Gypsy 6, series 2, 200 hours, reasonable price, enquiries—Starways, Ltd., Speke Airport, Liverpool. [5415

FOUR Link trainers, complete, brand-new condition.—Midesetra, Ltd., 34, Market Place, Reading. Tel. Reading 4970. [5309

FIELDS have customers asking for your aircraft.—Field Aircraft Services, Ltd., Croydon Airport, Croydon. Croydon 7777. Cables, Fieldair, Croydon. [0259

ALLEN AIRCRAFT SERVICES, LIMITED, Rapides, Queen III engines, Tiger Moth, special bargain, finished silver 12 months' C. of A.—Tel. Cru. 4585. [5566

PROCTOR V, as new condition, 12 months' C. of A.; new engine propeller, all hours since overhaul; twin channel Murphy V.H.F.; best offer secures.—Box 6128. [5555

IMPORTANT GUIDE

This unique handbook "Engineering Opportunities," outlines over 200 home-study Courses of technical instruction, including **Aeronautical Engineering, Aeronautical Design, Aero Engines, Air Navigation, Aircraft Engineers' Licences (Ground Engineers), A.F.R.Ae.S., A.M.I.Mech.E., R.A.F. Maths,** etc.

Our courses have been approved by the **Royal Aeronautical Society** and

WE GUARANTEE

"NO PASS—NO FEE"

A copy of this enlightening guide to well-paid posts will be sent on request—**FREE.**

British Institute of Engineering Technology
306, Shakespeare House, 17-19, Stratford Place, London, W.1

B.I.E.T.

Aero & Jig & Tool Draughtsmen in Great Demand

MEN AND YOUTHS

There is an insatiable demand for Aero, Jig and Tools, etc., Draughtsmen and Inspectors. So acute is the present shortage that employers are only too anxious to engage those with no previous practical experience who are able to prepare neat and accurate drawings.

QUALIFY AT HOME—IN SPARE TIME

After brief, intensely interesting study—undertaken at home in your spare time—**YOU** can secure an attractive and interesting post as **Aero-Draughtsman.** Numerous vacancies are also available in **Electrical, Mechanical, Plastics,** etc., branches of Draughtsmanship.

FREE GUIDE

The Free Guide contains 132 pages of information of the greatest importance to those seeking such success compelling qualifications as **A.M.I.Mech.E., A.F.R.Ae.S., A.M.I.P.E., A.M.I.E.E., Matric. and B.Sc.,** etc., also **R.A.F. Entry** (Maths., etc.), together with particulars of our remarkable Guarantee of

SUCCESS—OR NO FEE

Write now for your copy of this remarkable publication. It may well prove to be the turning point in your career.

NATIONAL INSTITUTE OF ENGINEERING

(Dept. 427), 148-150, HOLBORN, E.C.1.
(South Africa Branch E.C.S.A., P.O. Box 8417, Johannesburg.)

Palmer

FOR SAFE LANDINGS

TYRES • WHEELS • BRAKES *Etc.*

BRITOOL ring wrenches are made in British, American and Metric sizes - midget to giant

Please write to us at BRITOOL WORKS, Wolverhampton, for details of complete range.

BRITOOL

JENKS BROTHERS LTD.

Don't live in the clouds!

Why wait for married quarters when you can provide your own mobile home out of income, and be assured of happy landings for the rest of your life!

Here is the perfect, fully furnished, ready-to-live-in

WILLERBY HOME

Undoubtedly the finest value in low priced living caravans. Spacious, homely, attractive. Length 22', width 7' 6" height 6' 9". One double bed and two single. Four separate rooms. Five Calor gas lights and oven type cooker. Convector type heater. Deep reaction spring interior mattresses, furnishing fabrics with curtains to match. Commodious cabinets, panelled with beautifully matched veneers, French polished. Separate toilet compartment.

(Ex. works) **£450**

OTHER MAKES ON SHOW FROM £150 TO £975

Any model can be yours for 25% down and 3 years to pay

MONTROSE

CARAVAN DISTRIBUTORS

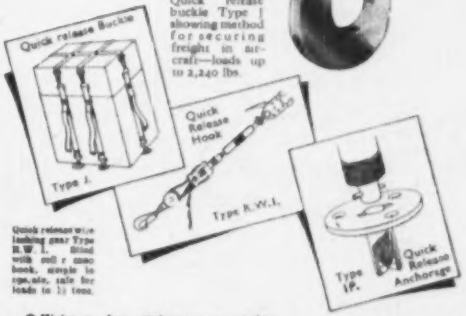
STOCKPORT RD., CHEADLE, CHESHIRE. (Gatley 6179)

★ A car from the Montrose fleet will pick you up in Manchester on receipt of a telephone call or telegram, and bring you to the world's best garden caravan showroom.

FHA F1

The *Fast* POSITIVE LASHING for all Loads!

Aerolex Quick Release Gear makes the lashing and stowing of Freight in Aircraft simple and easy to carry out. Lashing equipment that is fast and positive for all loads whether compact or bulky.



Quick release buckle Type J showing method for securing freight in aircraft—loads up to 2,240 lbs.

Quick release wire lashing gear Type R.W.J. fitted with end ring hook, simple to operate, safe for loads to 1½ tons.

● **Write to-day stating your requirements for buckles, snap hooks, roller hooks, coupling sleeves, wire lashing gear, anchorage points and shear pins.**

Quick release anchorage Type No. 1 complete with standard pin plug Type 1P for loads up to 3/4 tons. Webbing to suit requirements.

AEROLEX LIMITED

AEROLEX QUICK RELEASE EQUIPMENT

CAMBERLEY · SURREY.

Telephone: Camberley 1500.

Among the present users are:
Air Ministry
British European Airways
The Bristol Aeroplane Co., Ltd.
Vickers-Armstrongs Ltd.

THE AERONAUTICAL WORLD IS SAYING——DEAL WITH:—

ROLLASON ENGINES LTD.

CROYDON AIRPORT
Tel. CRO. 5151/3 CRO. 7744 Ext. 69.

LARGE STOCKS OF **DE HAVILLAND GIPSY MAJORS, QUEENS III's, II's, and I's—ARMSTRONG SIDDELEY CHEETAH IX's and X's**

ALL ENGINES HAVE BEEN SERVICED AND ARE READY FOR IMMEDIATE INSTALLATION
ENGINE HOURS VARY FROM NIL SINCE EITHER NEW OR COMPORT OVERHAUL. QUANTITIES OF SPARES ALWAYS AVAILABLE.
MAY WE QUOTE FOR YOUR REQUIREMENTS.

VERY HIGHLY COMPETITIVE PRICES QUOTED

Jubilee
PATENTED
WORM DRIVE
CLIP

Absolutely leakproof joints on Air, Water, and Oil lines, are swiftly and easily made by using "Jubilee" Worm Drive Clips. They stand up to any pressure.

✱ Write for details quoting reference

THE FINEST CLIP IN THE WORLD.

L. ROBINSON & CO. (GILLINGHAM) LTD.
Gillingham Kent

✱

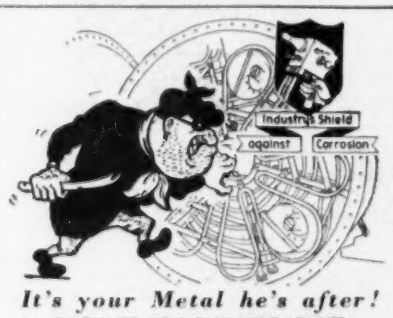
The Performance of Civil Aircraft

By F. B. Baker, M.A. A really up-to-date guide for civil pilots and aircrews. It deals not only with types of aircraft in general use, but with the future development of gas turbine engines at high altitudes. 114 illustrations. 35/- net.

PITMAN *Parker St., Kingsway, London, W.C.2*

THE COLLEGE OF AERONAUTICAL AND AUTOMOBILE ENGINEERING
(The Chelsea College)

Complete practical and technical training for entry to Civil and Commercial Aviation, or the Automobile industry.
Entry from School-leaving age.
Training for
AIRSCREW TECHNICAL EXAMINATION
(Issues and Endorsements)
Syllabus from Bursar
Sydney Street, Chelsea, S.W.3.
Telephone FLAxman 0021



It's your Metal he's after!

SAFEGUARD VITAL EQUIPMENT AGAINST ROBBER RUST...

It's no use waiting until Robber Rust has got your most valuable piece of equipment. You can never get it back. The only sensible thing to do is to keep him out altogether with a protective coating of sprayed zinc or aluminium or whatever metal is most suitable. Metallisation Ltd., are the pioneers of the Wire System of Metal Spraying, and are lifelong enemies of Robber Rust. They have beaten him so consistently that today he has only to see an example of their work and he is off in search of an easier crib to crack.

Metallisation

Contracting: Metallisation Ltd., Pear Tree Lane, Dudley, Worcs.
Metal Spraying Plants: Metallisation Ltd., Barclays Bank Chmbs., Dudley, Worcs.

M.W.5

Printed in Great Britain for the Publishers, Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1, by The Cornwall Press Ltd., Paris Garden, London, S.E.1. *Flight* can be obtained abroad from the following: Australasia and New Zealand: Gordon & Gotch, Ltd. India: A. H. Wheeler & Co. Canada: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. South America: Central News Agency, Ltd. Wm. Dawson & Sons (S.A.), Ltd. United States: The International News Co. Entered as Second Class Matter at the New York, U.S.A., Post Office.

HIGH SPEED FINISH

is used on Britain's latest Night Fighter

-the **A.W. METEOR N.F.II**

TITANINE LIMITED · COLINDALE · LONDON · N.W.9 *Telephone: COLindale 8123 (6 lines)*

Associated Companies Titanine Inc. U.S.A. N.V. Titanine, Holland; Veroici, Titanine, Italy

THE BRISTOL AEROPLANE COMPANY LIMITED
ENGLAND